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## ORIGINAL MEMOIRS.

### MULTIPLE CARCINOMATA FOLLOWING CHRONIC X-RAY DERMATITIS.*

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THE recent death of Prof. Fuchs of Chicago from metastatic X-ray carcinoma leads me to report in detail the history and present condition of another case of multiple epithelial carcinomata which has been under my care since 1897.

In delaying this report until the present time I have been greatly influenced by my personal regard for the patient; but the above case, the fourth fatal one in the United States, and a slowly increasing list of undoubted instances of X-ray carcinoma, here and abroad, makes it imperative that the attention of dermatologists and surgeons should be thoroughly aroused to the great *danger* of *all persistent X-ray ulcerations* and especially to those which have followed, with a few years interval, the chronic skin lesions of the earliest operators.

The first published account of the injurious effects of the X-ray with which I am familiar, was a paper by Marcuse,

* Read by title at a meeting of the American Surgical Association held at Washington, May, 1907.

"Dermatitis und Alopecie nach Durchleuchtung mit Röntgenstrahlen" in the Deutsche med. Wochenschrift, No. 30, 1896.

From 1897 the literature of this subject has grown each year. The earlier articles dealt with the immediate effects of the X-rays, dermatitis and burns; then it soon became recognized that these lesions were most excruciatingly painful and extremely slow to heal; further experience showed that some lesions closed with great difficulty only to break down again and again, and finally formed chronic ulcers:—then came the first report of cancer developing in a chronic ulcer, and finally the first death from metastatic carcinoma.

In an excellent article written by Dr. Richard Mühsam, and published in the Archiv für klinische Chirurgie, 1904, No. 74, "Über Dermatitis der Hand nach Röntgenbestrahlung" may be found a full bibliography of the literature up to that time and a brief résumé of the histology of the characteristic lesions with which we are unfortunately too familiar.

## CASES OF X-RAY CANCER.

I and II.—In 1903 Sick reported two cases, both in X-Ray operators, the first, after years of severe changes in the skin of the arms, neck and face, finally developed an ulcer upon the back of the hand, which soon took on the typical appearance of a carcinoma, and required amputation at the shoulder joint.

The second, with similar skin lesions of six years duration, also developed a chronic ulcer on the hand, which was excised and showed upon microscopic examination the typical picture of a skin cancroid, with cancer nodules in the cutis—the material from these cases was examined by Unna.

III.—Dr. Blacker of England, mentioned in *Medical Record,* Oct. 22, 1904, for a long time suffered from an X-ray burn of the hand which was neglected till the cancer which had developed had extended up the arm and involved the axillary glands, when it was too late for operation.

IV.—Clarence Daly. Personal communication from Dr. Samuel Lloyd of New York and Dr. W. B. Graves of East Orange, N. J.

This patient was very seriously burned on both hands years before, in working with X-Ray tubes. He was treated at many different hospitals. Skin grafting was tried without result, until finally epithelioma developed on the right hand and on the base of the little finger of the left hand. At the time of Dr. Lloyd's first examination the right hand was infiltrated with carcinoma and the axillary glands were involved.

The arm was amputated at the shoulder joint and the glands above and below the clavicle removed. Amputation of the left hand was advised but refused. This was August 8, 1902. The ulceration gradually increased in size and depth and the left arm was amputated by Dr. Graves on March 16, 1904. Death followed from mediastinal recurrence in October, 1904.

V.—Epithelioma of finger of X-ray machine manufacturer (communication from Dr. Lloyd).

VI.—Personal communication from Dr. W. B. Coley, Surgeon of Rochester, New York. For five years had been using X-Rays continuously. Ulcerations present for six months on the backs of both hands, specimens from which were examined by Dr. Welch and found to be undoubted epithelioma. Amputation of right hand above wrist and thorough excision of ulceration on left hand October 10, 1904. Subsequent recurrence in axilla and death.

VII.—Bertha Fleishman, San Francisco, death. Quotation from New York *Sun*, April 24, 1907.

VIII.—Foulterton's Case. *Lancet*, May 6, 1905. At a meeting of the Pathological Society of London, Foulterton reported the case of a surgeon who began systematic work with the X-rays in 1897. In May, 1903, had a severe attack of dermatitis, blistering of the skin on back of index and middle fingers of left hand, ulcers resulting healed in about four months. New skin was thin and tender and showed nevoid looking patechiæ. The nails fell out and new ones were hard and brittle. In December, a second attack of dermatitis again caused ulcers on first and second fingers. Ulcers on index finger remained open and in April, 1904, began to assume a malignant character. In September of that year, finger was amputated at the metacarpo-phalangeal joint. Sections of index finger showed typical squamous celled cancer.

IX.—Personal communication from Dr. L. L. McArthur of Chicago, dated April 26, 1907. Patient was the first photographer to develop X-ray plates in America. "He early developed the chapped and fissured hands which go with the exposure to the ray, *especially* in those who combined the development of their plates with their X-ray work. For the last three years he has been having, from time to time, minor surgical procedures in the way of removal of a phalanx now and then, until three fingers of the right hand and two on the left had been sacrificed. After various plans of local treatment and a trip to Europe in search of remedial agents, he came to me for the first time with an enormous axillary involvement. This was indubitably squamous celled carcinoma. The radical operation with removal of portions of the pectorales and a dissection of the axilla en bloc failed to effect an arrest of the trouble. Recurrence took place very promptly, and within three months again filled the axilla and involved the supraclavicular glands. Deeming it hopeless to subject him to further surgical interference, trypsin injections were given, with a resulting liquifaction of the axillary mass to a nonpurulent, sero-sanguinolent fluid containing immense masses of epithelial cellular detritus, as was shown on opening and draining the same.

After lingering for six weeks he finally succumbed to a multiple metastasis on April 23, 1907."

X.—"The second case was that of a physician who combined his electrical therapeutics from his static machine with the taking of pictures of his surgical cases. He, too, developed his own plates and constantly had his hands stained with the photographing solutions. He had the usual history of a chronic dermatitis with ulcerative processes that refused to heal, and required removal of the terminal phalanges on his left index and middle fingers. When he came to me it was with a typical epithelioma on the remains of the left index finger, and numerous senile keratoses on the back of both hands. I amputated the finger, which microscopic section demonstrated to be carcinomatous. I removed by a deep shaving-like cut the senile keratoses and grafted the same. I secured primary union in the grafts, had a mild infection along the stitch line in the amputation and an aseptic result in the axilla which I cleaned out radically though no glands were distinctly palpable at the time of the operation. No metastases were found in those lymph glands removed from the axilla which were examined. At present he is in good health."

From a careful search through the literature and some personal inquiry these ten cases of undoubted X-ray cancer are all which I have been able to find. I have purposely excluded a few recorded cases of carcinoma developing in lupus tissue after Röntgen treatment, and one or two cases of epithelioma, following burns, for I wish to limit the question under discussion to cancer resulting in the X-ray operators who for years have followed their work in spite of previous inflammations of the skin and persistent lesions.

If my case be included, there are eleven cases, of which five have proved fatal, and as one of Sick's, reported in 1903, had to submit to a shoulder joint amputation, it is probable that this result was also a fatality. The prognosis in X-ray cancer would therefore appear appalling if it were not for the very great likelihood that all fatal cases have been published while no record has been made of the much larger number of sufferers, who after excisions or minor amputations have as yet shown no evidence of recurrence. Though it is obvious that surgeons will very naturally hesitate, in the case of a brother physician, to add publicity to misfortune, there are so many unfortunates throughout the country, suffering from chronic lesions of all grades of severity, that it is now a duty

I think for all who have charge of these cases to publish their experiences in order that our knowledge of this difficult subject may be increased.

The case which I have to report is that of an X-ray operator, who, as a *young man,* first began X-ray work with a large static machine in March, 1896; after October of the same year a powerful twelve-inch coil was used. Exposure lasted for several hours each day, at a very *short distance* from a *low vacuum* tube. About the middle of November hands became red and dry, and in a few days very painful and greatly swollen. Under black-wash the dermatitis subsided, but the finger nails first became dry and striated, then softened and finally sloughed off (the patient felt convinced that this condition of the nails was greatly aggravated by the use of chromic acid in development of the X-ray plates). In spite of the fact that one per cent. orthoform ointment had to be used almost continuously to relieve the intense pain, work was continued until April 1, 1897, when the onset of another very severe dermatitis, with the formation of enormous blisters, and pain "beyond description," necessitated ward treatment for a month. White-wash gave considerable relief. All forms of treatment by ointments, powders, and washes, which Prof. J. C. White could suggest, proved useless; the chronic ulceration which now involved most of the backs of the fingers of both hands refused to heal. Orthoform ceased to relieve the pain. At the suggestion of the patient Reverdin grafts were applied on July 10, 1897, to the tip of the left forefinger, which presented the appearance of a sluggish ulcer, with rather exuberant granulations and unhealthy-looking edges. These pin-point grafts "took" and grew. Accordingly on August 13, 1897, under ether, all the ulcerated areas were cleaned up, shaved down to an apparently normal base, and Thiersch-grafted; fourteen different grafts being applied. Contrary to all expectations, the great majority of these grafts adhered and "*have never broken down since,* nor do they show the eczematous condition, which now exists on the areas not grafted." "Pain ceased absolutely from the time of operation, and areas then grafted are in good condition to-day." "Epithelioma has *never* developed in any graft which *completely* took at this time." (I quote from a letter which the patient wrote me in 1905.)

Though all X-ray work was stopped for a year ulcers developed upon the fingers, and again in spite of all treatment refused to heal until excision with skin-grafting was carried out; after several operations all the chronic lesions were successfully grafted or healed spontaneously, except some very persistent ulcers on the ends of the ring fingers of both hands and the little finger of the right hand, which in spite of six or seven operations refused to heal.

In July, 1902, the persistent ulcerations at the tip of the ring fingers were again excised and grafted. The grafts did not take. The specimens sent to the pathologist were misplaced and not until October, 1902, was the report received that both ulcerations showed unmistakable evidence of carcinoma. In the meantime these finger tips had become excessively sensitive and painful and showed an angry-looking ulcer, with somewhat raised and indurated edges. On or near October 31, 1902, both of the ring fingers were amputated at the knuckles.

I. The ulcer on a ring finger is shown in Fig. 1.
II. The gross appearance under a low power in Fig. 2.
III. The microscopic picture in Fig. 3.

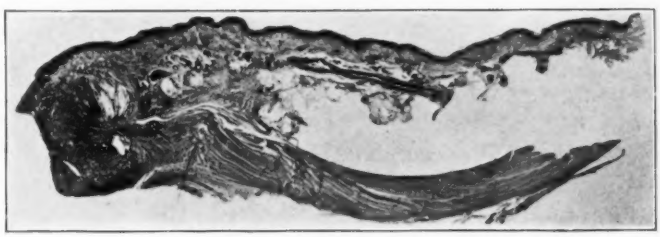
During the period from October, 1902, until June, 1905, a dozen or more operations under ether were performed—amputation of the middle finger of the left hand, removal of the tips of the second and third fingers of the right hand, and numerous excisions of keratotic areas or chronic ulcerations on the dorsum of the remaining fingers or backs of the hands. Figs. 4 and 5 show the conditions of the hands.

In June, 1905, for the first time in eight years, the patient was free from pain and no dressings had to be worn. Both hands could be placed in his trouser pockets. The left hand was soundly healed; the right showed one superficial ulceration at the base of the third finger, with considerable thickening of the skin about it and numerous other keratotic areas. Unfortunately during the summer the favorable condition did not endure, but steadily, though slowly, several places on both hands began to break down. Under date of November 8, 1905, the following notes were made: "For three months following a slight bruise and subsequent infection, there has been a great deal of pain in the tip of the stump of the little finger on the right hand; gradually an ulcer formed,

FIG. 1.

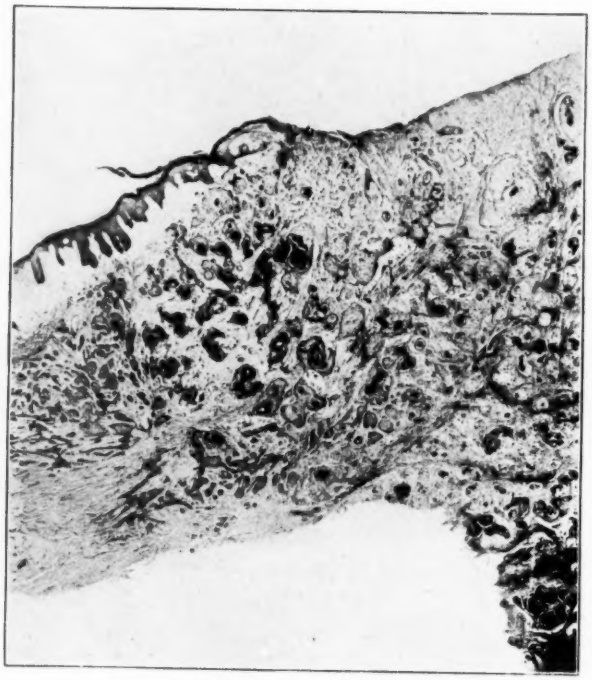
Ulcer at end of amputated ring finger, Oct., 1902.

FIG. 2.



Ring finger, 1902. Low power.

FIG. 3.



Ring finger, 1902. High power.

FIG. 4.

Condition of hand, June, 1905.

FIG. 5.

Condition of hand, June, 1905.

FIG. 6.

Ulcer at end of little finger, Nov., 1905.

FIG. 7.

Keratoses on back of hand. Carcinoma at base of middle finger. Nov., 1905.

about the size of an old-fashioned three-cent piece, which looks very angry and resembles those found in the ends of the fingers in 1902."

Figs. 6 and 7 show the condition. At operation the end of the little finger was removed and a suspicious ulceration at the base of the third finger throughly excised. The back of the forefinger over the second phalanx showed a superficial unhealthy-looking ulceration which involved the old graft; on the ulnar side of this finger were several macerated warts, which had been excessively sensitive and painful. On the radial side were numerous cracks and fissures, with some keratoses, but nothing suggesting anything malignant. All these lesions were excised, as were seven other places on the backs of the hands and Thiersch grafts were applied. All of these grafts took except those on the back of the forefinger, which sloughed and left exposed the white and glistening but not necrotic aponeurosis of the extensor tendon. Dr. Wright's examinations showed that the ulcer on the end of the little finger was not malignant, but that the specimen removed from the base of the third finger was a typical epithelioma. One or two others suggested beginning cancerous degeneration.

During the winter and spring of 1906 these areas broke down further, and the middle joint of the first finger, from sloughing of the extensor tendon became flexed and discharged synovial fluid. For a time there was some infection, but this soon passed away. During the summer the patient suffered much from this persistent ulceration. The back of the middle finger also began to break down.

In November, 1906, under ether, the ulceration and unhealthy granulations on the back of the first finger were again excised. Examination by Dr. Wright of frozen sections showed epithelioma, or at all events invading epithelium; accordingly the excision was extended into apparently sound tissue at the margins, and the base was removed down to the bone. The dorsum of the third finger was thoroughly scraped with the knife, the tip of the little finger of the left hand removed for persistent ulceration, and several suspicious areas excised. All open surfaces were grafted successfully except the backs of the second and third fingers. A subsequent report from Dr. Wright confirmed his diagnosis of superficial epithelioma in the tissues

removed from the back of the forefinger; the ulceration on the third finger was negative.

By January 1, 1907, there was some evidence of healing from the edges in both ulcerations. The patient wished very much to delay radical treatment of the first finger, for as the third finger was stiff, amputation meant almost total disability of the right hand.

The condition of the hands on April 25, 1907, is shown in Figs. 8 and 9—*the result of ten years of treatment and twenty-five operations under ether.*

*On the left hand* the thumb is sound and serviceable. The forefinger is stiff, but shows no lesions. The third and fourth fingers have been amputated. The little finger lacks a terminal phalanx. On the back of the hand there are a few keratoses, but no ulcerations. *On the right hand* the thumb is useful, but at its base is a small ulceration, and the whole ulnar side is covered with thickened epithelium. The forefinger is flexed and presents an ulceration over its middle which is undoubtedly malignant. (This finger will be amputated in June.) The middle finger is stiff. There are a few sluggish granulating areas on the dorsum, but these are healing in. The fourth finger is lacking, as is also the end of the fifth. There are numerous keratoses, but no other ulcerations on the back of the hand.

The palmar surface of both hands is normal. The skin grafts, which are outlined in black, are soft, movable, and some of the thicker ones have almost the appearance of normal skin.

The axillary glands have been somewhat enlarged for many years, but show no evidence of increase in size.

From the first demonstration of epithelial cancer in 1902 on the tips of the fourth fingers, undoubted malignant degeneration has been found in eight other areas, so that we have the extraordinary development of ten different epitheliomas in one case in five years. As the report by Dr. White will show, from such a condition there are all grades of what might be termed precancerous changes, down to simple ulceration or benign keratosis. In this as in the other reported cases, persistent ulceration has for a time, from three to six months, always preceded cancer.

FIG. 8.

Condition of hand, April, 1907.

FIG. 9.

Condition of hand, April, 1907.

FIG. 10.

Hand of G., May, 1907.

FIG. 11.

Hand of G., April, 1907.

In addition I will report a second case of chronic but much less severe dermatitis to show the advantage of skin grafting for recurring fissures; and the report of Dr. Mallory upon the recurrent growth which may prove to be a sarcoma.

Mr. J. G., X-ray operator, has suffered for many years with the milder varieties of X-ray lesions such as atrophy of the sweat glands, more or less persistent eczema, marked atrophy and longitudinal ribbing of the finger nails, with the characteristic X-ray telangiectases and keratoses. During the winter most painful fissures occurred over the extensor surfaces of the joints. It is of interest to note that none of these lesions are present over the proximal phalanx of the ring finger, which was protected from all early exposures by a broad gold ring.

In May, 1906, the keratoses and fissures on the back of the right hand were excised and grafted. Fig. 10 shows condition ten days after the operation. All of the grafts took. These were prominent and raised above the surface for a month, but at the end of that time were level with the surrounding skin and remained solid until September 15, when a spot on the terminal phalanx of the ring finger became ulcerated. Under gas and ether on October 18 this ulceration was freely excised and the radial fourth of the nail with its matrix extirpated. The skin at the margin of the nail was approximated with plaster and another graft was applied. In ten days the wound was completely healed and free from pain. This finger remained painless and healed until the middle of March, 1907, when the distal part of the graft on the radial side began to increase in size and show well-marked vascularity. After two weeks there was a slight discharge near the edge of the nail.

Examination by Dr. Wright of this specimen led him to make a diagnosis of spindle-celled sarcoma, though by some the growth was thought to be a granuloma.

By April 23, 1907, the growth had become decidedly larger and was apparently extending backward into the proximal graft. See figure 11. After careful consideration of the possibility of the return of the growth excised in October, but chiefly influenced by the anatomical conditions, which could not, in all probability, be rectified by removal of the nail and grafting, the

terminal joint was amputated under gas and ether. The wound was completely healed in a week.

Examination of tissue from finger of J. G. following exposure to X-rays by Prof. Mallory, of Harvard Medical School.

The section shows an oval, cellular mass of tissue partially surrounded by more or less normal fibrous tissue. The cellular mass at its outer end is ulcerated and covered with fibrin, cells and dried necrotic tissue. The more normal tissue is covered with epidermis. The oval, cellular mass of tissue is quite sharply defined and is limited by a layer of dense, fibrous tissue. It is composed of rapidly growing connective tissue cells and of a small number of thin-walled blood vessels. The connective tissue cells are typical, that is, they have flat, oval nuclei and contain one to three coarse chromatin masses. The cytoplasm is made out with difficulty. In places the cells are bordered by very delicate fibroglia fibrils. Everywhere the cells are separated from each other by a relatively large amount of ordinary (collagenous) fibrils. The cells and their fibrils tend to form small bundles which run in all directions. Mitotic figures are numerous, one to three showing in nearly every oil immersion field. While the cellular mass of tissue at its base is sharply defined, on both sides, it gradually blends with the adjoining connective tissue.

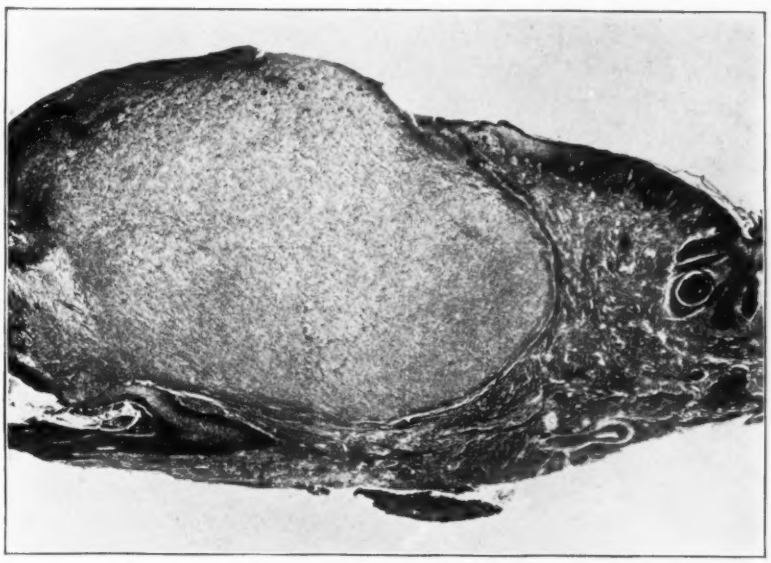
The adjoining tissue of the finger shows infiltration with numerous groups of lymphocytes. Otherwise there appears to be no change in it. It is difficult to give a positive diagnosis in this case. The rapidly growing mass of connective tissue may be either an unusual form of reparative action on the part of connective tissue or it may be a connective tissue new growth, namely, a rather slow growing spindle-cell sarcoma. Personally I favor the former view owing to the lack of any definite evidence as yet of invasion.

F. B. MALLORY.

The microscopical appearances under the low and high power are shown in Figs. 12 and 13. Note beginning epithelial infiltration at the extreme right of the photograph.

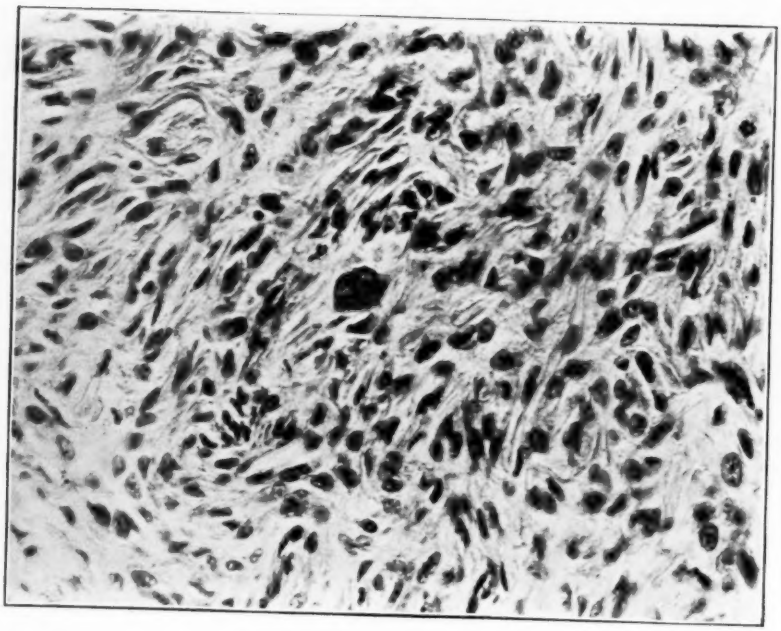
During my long experience with the first case I have learned many things about skin grafting, and now have no hesitation in recommending it, as the best treatment for all chronic X-ray lesions. Early in the history of this case, the tissues were remarkably vascular. There frequently occurred little hemorrhages in the skin, which were often the starting-point of subsequent ulceration; there appeared to be an almost complete vaso-motor paralysis. Owing to the chronic eczema no adequate disinfection was possible so that most of the early

FIG. 12.



Tissue from hand of G. Low power. April, 1907.

FIG. 13.



Same as Fig. 12. High power.

operations were somewhat influenced by sepsis, yet in spite of this the grafts often took surprisingly well. Hæmorrhage proved to be most troublesome, not only at the time of operation, but subsequently, when blebs would form under the grafts, and unless speedily snipped with scissors would detach them. Hæmorrhagic infiltration of the grafts was often noticed on the second or third day, doubling their thickness.

As a rule I applied a finger tourniquet before excising, as much of the work had to be done with great care, especially when dealing with a suspicious ulceration over an aponeurosis or tendon sheath. Fortunately, no deep infiltrations have yet occurred. After excision firm pressure by gauze was applied to the raw surfaces for ten minutes, and the hands were then exposed to the air and held aloft. No grafts should be applied until all bleeding has ceased. So far as possible an attempt should be made to bevel the edges of the wound. After shaving off granulations to get a smooth surface, the base of the wound is next examined for vascularity, in order to determine the thickness of the graft which should be used. While the ultimate result, if successful, which a thick graft gives, is most desirable, I feel sure that I have occasionally jeopardized healing by attempting to place a thick graft upon a very small spot, or upon such bloodless tissues as the backs of the fingers. I now use thinner grafts. If these fail, another operation should be done when the surface has become covered with granulations. A very small spot upon the fingers is most difficult to graft. I have had the best results by cutting a special graft for each place, thickest in the middle and gradually thinning towards the periphery, in order that it may fit evenly into the concavity of the wound. When possible, the whole forearm was firmly fixed with adhesive plaster to a well padded palmar splint before any of the grafts were applied. More than once from a sudden movement of the patient or an assistant, many of the grafts have been brushed off. The patient should be kept under full surgical anesthesia until the dressing is completed.

After having tried all the methods of dressing the

grafts with which I am familiar, I have adopted the following technique, and after-treatment. The grafts are so cut and arranged that they *do not overlap* either the edges of the wound or each other. If on the back of the hand, they are covered with a piece of rubber protective tissue which extends not more than ⅛ of an inch beyond their edge; if on the fingers, narrow strips of protective, arranged in an imbricated fashion, encircle $^2/_3$ of the finger, and are stuck in position with blood, which soon coagulates. A small absorbent gauze pad is then placed over the protective and then *direct downward* pressure is applied by a piece of gauze or bandage, which is tied with a surgeon's knot on the palmar side of the splint. I was forced to resort to this manœuver by the discovery that the smaller grafts now and then were carried from left to right by the ordinary application of the bandage. Owing to the amount of exudation which occurs immediately after the operation, I have found it unwise to adopt immediate exposure to the air, as is now customary in *normal* skin-grafting. After twenty-four hours, with the hand continuously elevated, the protective is carefully removed. Longer delay in this case has almost always been followed by maceration of the grafts.

At the first dressing, blebs, if present, are snipped with the scissors and their contents gently expressed. Any lateral movement of the graft must be avoided. All the *edges* of the individual grafts are then greased with lanolin, or with the following ointment which was found to be less macerating.

| | |
|---|---|
| Benzoinated lard..... | 175 |
| Lanolin ..... | 25 |
| Ichthyol ..... | 4 |
| Silver citrate..... | 1 |

The grafts were then covered with a cage and allowed to dry, exposed to the air, and so treated for the next week whenever possible. Often, however, the sensitiveness and pain after half an hour's exposure were so great that the whole surface had to be covered with the ointment.

Almost without exception the pain in these ulcerated areas as well as in the X-ray burns which I have excised, has ceased from the time of operation. It is interesting to note that in one instance thick grafts grew even on the base of an epitheliomatous ulcer, but within three weeks became excessively hypertrophic. After subsequent amputation of the finger, sections showed carcinoma invading the bottom of the œdematous graft.

Though future events may prove that my treatment of this patient has been too conservative, his present condition would seem to justify it.

In order that the abundance of material which has resulted from all these operations may prove of value to dermatologists, interested in the study of the pathological conditions induced by the X-rays, Dr. C. J. White has kindly made a careful examination of all the slides which have been preserved, and his exhaustive report forms a most valuable addition to my paper.

The clinical appearances of the chronic X-ray dermatoses, suggest a precocious and extreme senility of the skin; microscopic examination, also, shows the most extraordinary changes, always of a degenerative character, unequalled in their severity and chronicity by the effects of any other agent.

In view of these facts and the histories of the eleven cases reported, I think the following conclusions are justified:

1. For the atrophic condition of the skin and the telangiectases nothing can be done.

2. Hypertrophic changes, keratoses and warts may with safety be treated in the usual manner. If such treatment fails, excision with or without skin grafting, will probably relieve the pain and result in a cure.

3. Excision and grafting will prove to be the best treatment for recurrent fissures.

4. All ulcerations, which, under ordinary treatment, remain open, after three months, should be thoroughly excised, and very carefully examined. The subsequent treatment de-

pending upon the result of the microscopic examination, should be skin grafting; further excision and grafting, or amputation.

5. As the history of almost all of these cases of severe and chronic dermatitis dates back to early exposures, with the protection which our present knowledge demands, it is to be hoped that the number of victims of too enthusiastic work in an untried field, will steadily diminish.

6. In the meantime, I have no hesitation in recommending the *early excision* of all *persistent X-ray ulcerations,* in order that subsequent malignant degeneration may be prevented.

## PATHOLOGICAL REPORT.

BY CHARLES J. WHITE, M.D.,

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The pathological report which follows is based upon the study of forty-three microscopic slides presented by Dr. Porter. The sections were already stained, for the most part by the hæmatoxylin-eosin, iron-hæmatoxylin and methylin blue-eosin methods. It is to be regretted that no fresh material was at hand for the special staining of connective tissue and elastic fibrils. The first sections date from July 17, 1902, and were as follows:

1. *Finger of Right Hand.*—Keratosis moderate. Rete somewhat hypertrophic and shows an increased tendency toward downward proliferation. Corium normal and presents no marked signs of inflammation. The deeper horizontal vessels, however, exhibit serious changes. In places veins appear displaying extraordinary mural thickening. No interior alterations are present beyond a slight enlargement of the cells but the outer coats are greatly hypertrophied. Here and there arteries are totally obliterated by endothelial overgrowth.

2. *An Ulcerated Area.*—The rete, where existent, is totally abnormal. The stratum corneum consists of a few lamellæ of non-nucleated cells. The stratum granulosum is absent. The stratum spinosum is made up of greatly dilated cells, the extra-nuclear protoplasm being much rarified and the nuclei shrunken, murally placed, or entirely gone. The palisade layer, however, shows comparatively normal elements. Here and there are masses of red blood cells, suggesting golden pigment granules and filling the whole depth of the rete.

As the ulcer is approached the spinous cells show more distinct

configuration but are horizontally elongated and interspersed with erythrocytes.

*Corium.*—Below this abnormal epidermis there are occasional masses of plasma cells accompanied by a rare mast cell. The papillary and subpapillary vessels are dilated and many are clogged with red cells. Larger deeper vessels are choked with endarterial masses of nucleated cells. This condition is extraordinarily abundant—the lumen of some vessels of great size being entirely obliterated.

Invading the entire corium are polymorphous masses of epithelial cells ranging from small strings to great clumps with many smaller epithelial pearls. The epitheliomatous masses are outlined by a limiting band of deeply staining cells. Within these peripheral bands the cells are often oval and greatly enlarged with correspondingly hypertrophic nuclei containing one or two nucleoli. Some of the cells are really enormous (fusion?) while around them appear epithelial cells whose limiting membranes are indistinct and whose nuclei have disappeared. The epithelial pearls are large, some of them consisting of a nucleated centre surrounded by 15 to 20 concentric hyaline rings.

Mitoses are rare and between these epithelial masses are numerous cells.

3. *From a Finger.*—For the most part the epidermis is normal although the rete is somewhat hyperplastic. In one place, percontra, the spinous layer has receded to three or four layers of somewhat amorphous cells illy defined from the underlying corium and exhibiting deeper proliferation suggestive of epithelioma while above a nucleated crust appears.

The corium shows in the middle and lower layers a few highly dilated lymph spaces and some moderately enlarged blood vessels surrounded by dense plasmomata with an occasional mast cell; while still deeper are seen blood vessels presenting an obliterating endothelial change, and again others with persistent but distorted lumen and thickened walls surrounded by dense envelopes of connective tissue.

4. *From a Finger.*—Within the lobules of epithelioma are many large oval and round, swollen, pale-staining cells—some of great size. The progressive steps towards the formation of pearls can be demonstrated easily. Again mitoses are rare.

5. *Finger of Left Hand* (see photograph 3).—*Rete.*—Where the epidermis is intact there is a marked parakeratosis and acanthosis. The horny layer is decidedly thickened and nuclei persist; the stratum granulosum is absent; the upper layers of spinous cells are flattened and elongated and more or less devoid of nuclei and the whole rete somewhat hyperplastic. In several places the epidermic origin of the epithelioma is plainly manifest and broad masses of tumor cells are seen in direct continuation with the overlying rete.

Throughout the depth of the corium are seen lobules and whorls of epitheliomatous cells between which the collagenous bundles form a delicate meshwork in which are lodged masses of mononuclear cells—for the most part plasma cells—and very numerous, small, dilated vessels. Before any degenerative alterations have developed the cells of the outer

layers of the lobules retain their prickles undiminished. With the onset of degeneration, however, we note a disappearance of these spongioplastic prolongations and a concentric arrangement of the cells. Within these onion-like lamellæ the cells assume a roundish configuration with occasional great perinuclear halos while in the centre of the mass appears a basic-staining substance reminiscent of keratin. These conditions well illustrate the epidermic derivation of the tumor masses by their analogy to the progressive cornification of the normal epidermis.

In other parts of the section the epidermis shows less keratosis while the rete produces long finger-like projections into the corium. Finally, in still other areas, there is ulceration. The lowermost layers of the rete alone persist as round or oval, swollen cells; while again all signs of the epidermis are wanting and the surface is formed by a highly cellular corium.

The vessels are everywhere dilated. The papillary and subpapillary channels are delicately widened and the interlobular passages show the same condition while in the non-epitheliomatous parts of the section the deep vessels are very conspicuous and here and there form great reservoirs like those seen in cavernous angiomata. These veins do not exhibit dilatation simply, for their walls are manifestly hypertrophic.

Curiously enough, pigmentation, which we associate so strongly clinically with X-ray dermatoses, seems to play no rôle throughout all these sections and hæmatin or melanin granules are conspicuously absent.

6. *Ulcer: Tip of Third Finger of Right Hand.*—This area presents a central ulceration with comparatively normal epidermis on each side. The floor of the ulcer is composed of string-like serpentine masses of epithelioid cells, groups of erythrocytes, polynuclear leucocytes and rather inconspicuous bundles of collagen. Lower down the field becomes less troubled. The pus cells and red corpuscles disappear. The epithelioid masses grow less numerous while mononuclear elements and connective tissue cells replace them. The epithelioid elements for the most part form worm-like processes; but in places this configuration is lost, branches develop or irregular masses are produced. These figures are composed of cells exhibiting large, oval or round nuclei which contain many nucleoli and are surrounded by meagre protoplasm with no retaining envelop. Here and there are especially large cells which seem to be pushing their way through lymph spaces.

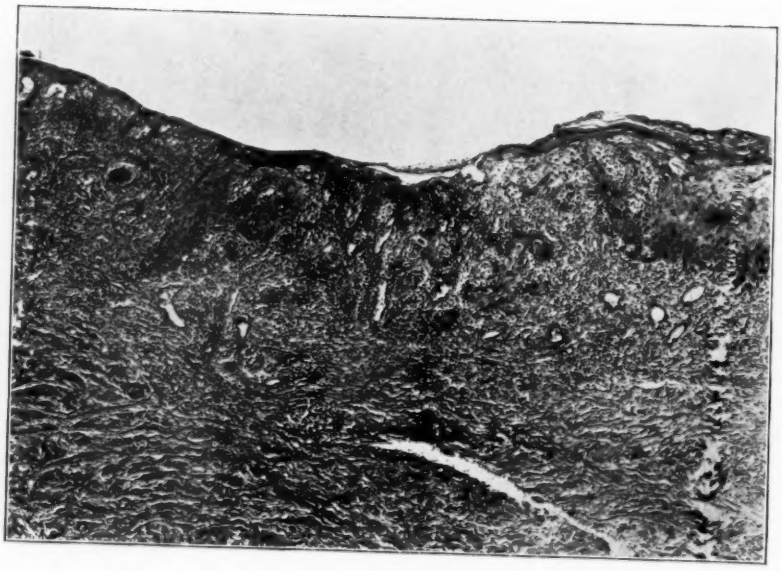
7. *From a Finger.*—Here the epitheliomatous process is young. The epidermis shows a loss of the stratum corneum. The granular layer is practically wanting save for an occasional attenuated cell with but few granules. The upper layers of the rete are elongated and more or less devoid of nuclei. The germinal cells on the other hand are conspicuously numerous, absorb the stains deeply but show an irregular demarcation from the subjacent corium and exhibit occasional downward buds.

The corium presents dilated subpapillary vessels with hypertrophied endothelial cells while the deep veins are enormously enlarged with frequent great thickening of their several coats. In the sub-papillary layer there are striking masses of plasma cells with infrequent mast cells

FIG. 14.

Section from periphery of ulcer on back of right wrist, December, 1903.

FIG. 15.



Section from base of ulcer on back of right wrist, December, 1903.

especially about the vessels. Here again can be seen delicate string-like masses of epithelioid cells which wind through the lymph spaces. Where these masses widen out their component cells display large swollen nuclei. Evidences of chromatophores or of free pigment granules are once more wanting.

Where epitheliomatous changes are absent the connective tissue nuclei are appreciably elongated and enlarged.

Thus far these sections date from the operations of July 17, 1902.

*Back of right wrist* December 23, 1903 (Fig. 14). The epidermic structures are normal with the exception of a slight tendency toward irregularity where the palisade layer and corium meet and here certain nuclei are surrounded by clear spaces while others have dropped out and are replaced by inflammatory cells.

The papillary vessels are dilated with hypertrophied endothelium. The corium is very dense and is filled with mononuclear cells not particularly grouped but generally distributed.

At the periphery of the section, however, where the section ends abruptly through ulceration (?) there are two lobules of epithelial cells. One suggests the epidermis irregularly cut (cross section?), the other contains œdematous cells, some without nuclei, others swollen with large vesicular nuclei, others containing granules of keratohyalin—in fact the whole picture is strongly reminiscent of the epidermic changes seen in molluscum contagiosum. The whole structure is surrounded by inflammatory tissue.

8. *Back of Right Wrist.* (December 23, 1903, Fig. 15.)—To one side of the ulcerated area shown in the photograph the epidermis is greatly modified. The palisade layer forms a straight but broken line owing to the disappearance of the papillæ. The cell nuclei are round or oval rather than elongated, show one or more sharply staining nuclei and are filled with chromatin granules. The intercellular spaces are irregular and often enlarged. The overlying layers of the rete are thickened and present swollen, œdematous, loosely opposed cells mostly free of nuclei and spines. The granular layer is represented by free kerato hyalin granules only, all other evidences of granular cells having disappeared. Lastly, the stratum corneum is composed of many dense lamellæ with numerous persistent nuclei. Thus the whole epidermis presents acanthosis and parakeratosis of pure type.

In the corium the absence of papillæ has already been alluded to while the subpapillary vessels are widely dilated and exhibit hypertrophic endothelial cells. Below, the collagen is comparatively normal save for occasional swollen bundles. Moderately numerous plasma cells and rare mast cells are present, sometimes grouped about a distended vessel. Finally, deep down in the corium appear prominent veins now enothelially now totally thickened.

The ulcerated portion (Fig. 15) presents a complex picture of masses of polynuclear leucocytes and red cells lying in a mediumly coarse reticulation with interspersed large dilated vessels filled with erythrocytes and coagulated fibrin and with occasional processes of epithelial cells with

grossly vesicular nuclei growing in from the sides or persisting as remnants. Below these abnormal elements lies a floor of thickened, rather anuclear collagenous bundles.

9. *Base of First Finger of Right Hand.* (December 23, 1903, Fig. 16.)—This represents scar tissue of considerable thinness. The epidermis consists for the most part of parallel bands of dense nucleated corneous lamellæ with occasional layers of rather amorphous, homogeneous, quasi rete cells containing infrequent round or oval nuclei surrounded by empty spaces. The germinal layer is represented by horizontally lying cells with flattened nuclei.

Even here the epidermis shows an effort toward downward proliferation foretelling future epitheliomatous growth.

The corium shows an absence of papillæ. The subpapillary layer is not as compact as one would suppose and its meshes are strewn with plasma cells, as seen in the photograph (16). There are frequent epitheliomatous cell nests, some solid and normal, others presenting varying degrees of central degeneration. In one (lying nearly centrally in the illustration) there is an outer ring of fair-sized, numerous, darkly-staining nuclei separated by a clear zone (artefact?) from the inner lamellated, flatly-nucleated layers which in their turn envelop an almost homogeneously degenerated centre containing an occasional giant nucleus and scattered nuclear debris and two large cysts partly filled with granulated protoplasm and mononuclear leucocytes.

The base is composed of practically normal fibrous tissue and the deep vessels when present exhibit no marked changes.

10. *Middle Finger of Left Hand.* (December 23, 1903.)—The tissue here is composed of a dense mass of fibrous elements devoid of all epithelial structures and free from vessels. It consists of practically structureless collagen on which lie small, round, solid-staining nuclei, the exact nature of which it is difficult to discern. In the deeper portion of the section the fibrous bundles form a reticulated mesh devoid of nuclei. The whole picture presents an extraordinarily blank mass.

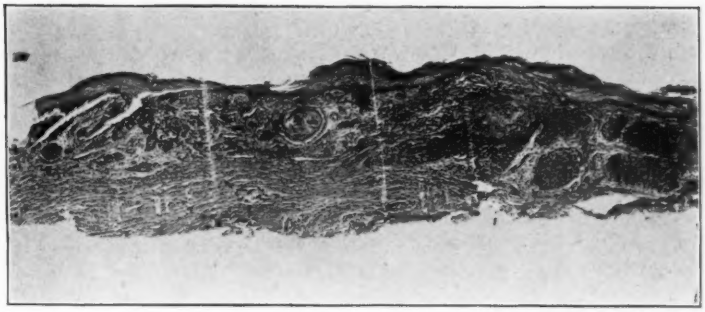
11. *Base of Third Finger of Right Hand.* (December 23, 1903, Fig. 17.)—The photomicrograph, 17, illustrates well the conditions present.

To one side an ulcerated surface of thickened collagenous material supporting numerous, many sized, mononucleated cells and small and large interstices containing erythrocytes with occasional whorls of œdematous and degenerated epithelial cells.

Where the epidermic covering is present the various layers are much altered. The rete shows an irregular base with marked tendency toward downward proliferation. The upper strata are emphatically hypertrophied while their component cells have lost their prickles and tend to coalesce, so that cell boundaries are gone, nuclei are swollen or absent and protoplasm is cloudy. The granular layer is represented for the most part by free kerato-hyalin granules. The stratum corneum is hyperplastic and nucleated. Again a marked picture of acanthosis and parakeratosis. Pigment is conspicuous by its absence.

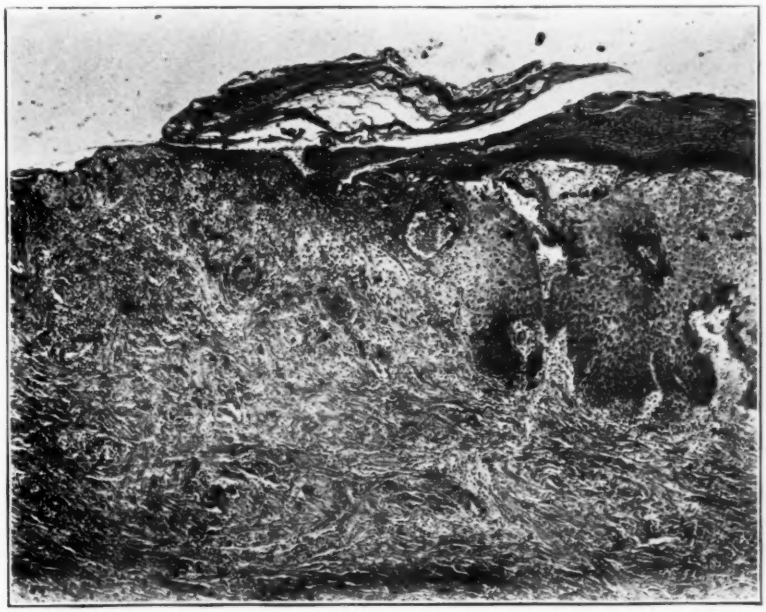
The corium exhibits only occasional papillæ which are filled with

FIG. 16.



Section from scar at base of first finger of right hand, December, 1903.

FIG. 17.



Section from tissue at base of third finger of right hand.

highly dilated vessels. The skeleton of the skin is composed of dense, rather anuclear bundles. Deeper vessels when present, show considerable thickening of their walls and constriction of their lumen and are surrounded by plasma and other mononuclear cells.

12. *Base of Little Finger of Left Hand.* (December 23, 1903.)—The process represented here is one of hyperkeratosis. The corium is dense. Vessels are slightly dilated and encompassed by extravasated mononucleated cells. Papillæ are insignificant. The rete is somewhat thickened for this part of the body but otherwise normal. The granular layer is manifestly hyperplastic and consists of five to six rows of large swollen cells with somewhat blunted ends and filled with masses of kerato-hyalin granules. The stratum lucidum is suggested but shows no traces of eleidin. The stratum corneum is conspicuously thickened and composed of layer upon layer of waving horny cells.

13. *Tip of Middle Finger.* (September 19, 1904.)—A very complex and irregular picture. The epidermis is mostly gone, the few surviving vestiges being quite atypical. The corium is totally abnormal and it is difficult to orientate oneself.

The upper layers are filled with dense masses of plasma cells and with sparsely scattered lymphocytes. Small dilated vessels with extraordinarily vesicular nuclei abound choked with red cells and occasional lymphocytes. The supporting fibrous tissue is in places dense, in others delicately reticulated, the intensity of the plasmomata corresponding directly with the density of the collagen. Here and there are small lobules of epithelial cells, occasionally whorls and more rarely branching tubules. All three forms exhibit absence of prickles and presence of highly vesicular cells containing one or two nucleoli and dense chromatin granules. The whorls and the tubules show a tendency toward central hyalin degeneration. When visible through comparative freedom from inflammatory invasions, the fibrous tissue shows a moderate proliferation of its nuclei.

14. *Base of Middle Finger.* (September 19, 1904.)—Great hyperplasia of the rete is the distinguishing feature here. For the most part the change is purely one of overgrowth in the depth of the layer. The cells are normal although somewhat œdematous and there is marked intercellular invasion of leucocytes. Here and there, however, the cellular elements show loss of prickles, vacuolization and tendency towards homogeneity. The stratum granulosum is represented mostly by free lying kerato-hyalin granules with occasional areas of partly developed granular cells. The horny layer is compact but otherwise normal.

The dividing line between epidermis and corium is so indefinite owing to the great overgrowth of the rete and the irregularity of the cut that it is difficult to ascertain the presence or absence of papillæ. There are numerous foci of snared-off epithelial clusters. The corium is dense and interspersed with numerous plasma cells, especially in the subpapillary layer.

15. *Keratosis from Dorsal Base of Middle Finger of Right Hand.*—This region presents an epidermic picture somewhat similar to the last

but here one finds the additional presence of a hyperplastic horny layer containing some nuclear cells. Again, the demarcation between corium and epidermis is well marked and the palisade layer more normal. Papillæ are present and hold dilated vessels—in one instance the whole papillary space is occupied by a vessel whose wide lumen is partially filled with lymphocytes, polynuclear leucocytes, erythrocytes and granular or reticulated fibrin. The corium presents the condition so frequently described in these sections, *i.e.*, dense collagen with dilated vessels and extravasated mononuclear cells.

16. *Tip of Little Finger.* (September 19, 1904.)—Another picture of parakeratosis and acanthosis with absence of papillæ and dense infiltrated corium.

17. *Ulcer on Back of Left Hand.* (October 16, 1904).—A complicated structure. The epidermis is entirely gone and the corium contains many polymorphous epithelial lobules and whorls; superficial dilated vessels blocked with red and with white cells; and innumerable endothelial and mono- and polynuclear elements. The epithelial whorls and lobules consist in the majority of instances of spine-bearing cells and present all stages of degeneration even to cystic spaces containing chromatin granules and reticulated or granular protoplasmatic debris.

The underlying corium is composed of dense fibres with elongated and enlarged nuclei and the deeper vessels are murally thickened.

18. *Keratosis of Right Wrist.* (October 16, 1904.)—Once more conditions now so familiar in this series of sections. Here one finds a hyperplastic rete whose upper layers are œdematous and degenerated; a total absence of granular cells and even independent granules; and an enormously overgrown horny layer bearing nucleated scales and leucocytic crusts.

Papillæ are insignificant. Subpapillary vessels slightly dilated. Collagen delicate in structure and supporting some mononuclear extravasated cells.

Sections from five other excised portions of this same date show pictures presenting the various characteristics which have marked those previously described and need not be detailed again.

19. *Graft Upon Middle Finger of Left Hand.* (October 16, 1904.)—The artificial epidermic covering is to all intents and purposes normal, but in one portion of the section the insidious process has redeveloped and below the rete one finds the now familiar epithelial lobules with central hyaline degeneration.

20. *Keratosis from Forehead.* (December 27, 1904.)—A newly invaded field. This section illustrates almost perfectly the epidermic characteristics of the sole of the normal foot. The rete is somewhat thickened, the cells of the upper transitional layers more or less vesicular and thrown up into jagged summits and depressions into which dovetail layer upon layer of normal horny cells. The corium, however, shows evidences of considerable inflammation. Vessels are dilated and plasmomata are frequent. Sweat and sebaceous glands hitherto not observed in these sections are present in great abundance and exhibit no marked deviation from the normal.

21. *Forehead.* (April 20, 1905.)—The intervening five months have wrought a great change. In the present section ulceration has occured and at the epithelial edge the cells of the upper layers of the rete are flattened and contain peri-nuclear halos or empty nuclear spaces; all semblance of granular cells has vanished; and a thin, parakeratotic horny layer is present. The lower layers of the rete are running riot. They have overcome the normal resistance of the corium and are proliferating enormously into the subjacent structures. Individual cells are often of enormous size and have become amorphous, anuclear swollen masses of protoplasm. In other areas large vesicular nuclei are present with but scant surrounding protoplasm. Cellular invasion is absent.

Farther down in the corium hugely swollen, anuclear bundles of collagen and some veins of extraordinary thickness and jagged, slit-like lumen appear. These unusual collagenous fibres would suggest an incipient colloid degeneration. The sweat glands remain strangely unaffected in the midst of these contiguous pathological structures.

22. *Hand.* (November 8, 1905.)—These sections are cut largely in so horizontal a plane that it would be injudicious to judge of the epithelial changes. There is, nevertheless, marked hyperplasia of the rete with occasional loss of nuclei especially in the germinate zone, general cloudiness of the cells and some intercellular leucocytic invasion. In places all vestiges of normal metamorphosis from rete to horn cells have gone and the free surface of the skin forms a chaotic mass.

The subpapillary layers, which alone are present, show fine reticulation supporting normal vessels and a general plasmomatic infiltration.

23. *Keratosis from the Hand.* (November 8, 1905.)—Here one has an ideal representation of a papillary and verrucous nævus. The rete is cast in individual rounded lobes formed by the fine and widely separated ascending papillæ and in places these lobes strongly suggest the lower rete conformation of molluscum contagiosum. In these lobes the rete is hyperplastic and fairly normal although perinuclear halos are common. The granular cells also exist in great numbers and one can count ten to twelve perfectly developed layers while above, before keratinization has been completed, as many more layers, half granular, half keratinous, appear. Above these increased strata lie row upon row of typical horn cells. Thus far the description has related to the interpapillary lobes but as is the rule in nævous pictures the rete and granular layers surmounting the papillæ do not present these hyperplasias but appear in comparatively normal amounts.

The papillæ are proportionately narrow but project far into the epidermis, in some instances to extraordinary distances. As is customary in this class of nævi the papillary and subpapillary vessels are slightly dilated and accompanied by a moderate number of mononucleated cells which lie between and under the epidermic lobes. The rete is practically normal.

24. *Ulnar Side of Forefinger.* (November 8, 1905.)—A mild degree of the preceding process, partly purely keratotic and partly slightly papillomatous.

25. *Ulceration of Finger.* (November 8, 1905.)—An intensely interesting picture of multiform and generalized degeneration which has affected practically all the various structures of the skin.

The epidermis is represented by remnants of previous downshoots from the rete which persist as barely recognizable, swollen, amorphous, acid staining protoplasm with occasional vesicular nuclei.

The papillæ of the corium are gone and the subpapillary layer holds numerous moderately dilated vessels within frequent, cloudy vesicular endothelial cells and with swollen lymphocytes, a few pus cells and reticulated fibrin in their channels. Collagen appears as straight, œdematous bundles between which extend chains of oblong plasma cells and more irregularly distributed lymphocytes. These plasma cells are histologically noteworthy for one seldom sees such well defined examples with their eccentrically placed, round nuclei bearing symmetrically arranged peripheral nucleoli.

These rows of alternating plasma cells and swollen collagen are interrupted by frequent vessels whose walls are cloudy and whose nuclei are vesicular and often of great size. Below, there are isolated or grouped masses of wavy or serpentine basic-staining elastic fibres (elacin) which lie between the fibrous bundles or form large, solid areas free from collagen.

26. *Outer Side of Forefinger.* (November 8, 1905.)—Another ulcerated surface disclosing many of the attributes of the previous section but not containing so many interesting histological features.

27. *Back of Right Hand.* (March 16, 1906.)—In this section there are stretches of epidermis and of ulceration. Where the former is present there is some tendency toward hyperplasia of the rete while the stratum granulosum is absent and the stratum corneum is represented by a thin homogeneous mass. Underneath, the corium is normal except for universally dilated vessels surrounded by plasmomata.

Where the epidermis is gone the corium is filled with circular or polymorphous lobules of epithelial cells which show no tendency toward degeneration. Multiple dilated vessels with lumens choked with red cells lie between these epitheliomatous masses and scattered universally throughout the depth of the derma are many mono- or polynucleated inflammatory cells.

28. *First Finger of Left Hand.* (March 16, 1906.)—A pathological condition similar to the last but here the epidermis is intact, exhibiting hyperplasia of the rete and of the horny layer, both of which are infiltrated with many leucocytes usually of the pustular type. Here also evidences of downward proliferation of the rete are visible. Finally there is abundant hæmorrhage everywhere.

29. *Tip of Third Finger.* (March 16, 1906.)—This piece of skin is free from epitheliomatous changes. For long stretches the upper layers of the epidermis are wanting while the corium exhibits in all parts many dilated vessels and multitudinous plasma cells.

30. *Excision.* (November 4, 1906.)—This section, the last in this long series, exhibits undiminished evidences of epithelioma.

The horny layer is practically non-existent, the granular layer is normal. The rete is in places thickened and displays numerous infiltrating leucocytes and at its germinate layer evinces signs of downward-penetrating proclivities. Papillæ are present and bear slightly dilated vessels. The subpapillary layer is delicately reticulated and holds frequent plasmomata and distended vessels containing fibrous meshes and occasional polynuclear leucocytes. Just below this level lies another series of plasma cell masses whose characteristics are strikingly visible and immediately subjacent are extensive areas of epithelial whorls and lobules surrounded by still further plasma cells.

The outer lamellations of these whorls show well differentiated prickle-bearing cells; but within lie degenerated, puffed cells, free from prickles and at times from cell boundaries, containing frequently giant nuclei or no nuclei at all and more mitotic figures than in the previous pathological history of the case. Finally, in the very centre of some of the whorls are found large cysts partially filled with coagulated fibrin, giant nuclei and abundant chromatic remains. Where these cysts appear the epithelial masses are more "pearly" than elsewhere.

This, then, is the detailed description of the pathological side of this discouraging history, and it is distressing to find at the end of this long series a slide exhibiting the most active phases of the disease.

One who has read the histological minutiæ of the case will be struck, presumably, by the manifold varieties of the pathological structures. Almost every known phase of epidermic deviation has been encountered, and the cellular, vascular, and protoplasmic alterations and degenerations have been most varied and interesting. The one striking omission in the case has been the unexpected absence of all pigmentary signs, especially when one remembers how prominent a clinical feature pigmentation is in X-ray dermatitis and its epitheliomatous sequelæ.

# PHAGEDENIC ULCERATION OF BOTH BREASTS DURING THE PUERPERIUM.

BY JOHN DE VINNE SINGLEY, M.D.,

OF PITTSBURG, PA.,

Surgeon to the Pittsburg Hospital.

THE following case is reported on account of the rarity of phagedenic ulceration other than the venereal type, and as an example of the rapidity with which such a process extends, well known in pre-antiseptic days, rarely seen now.

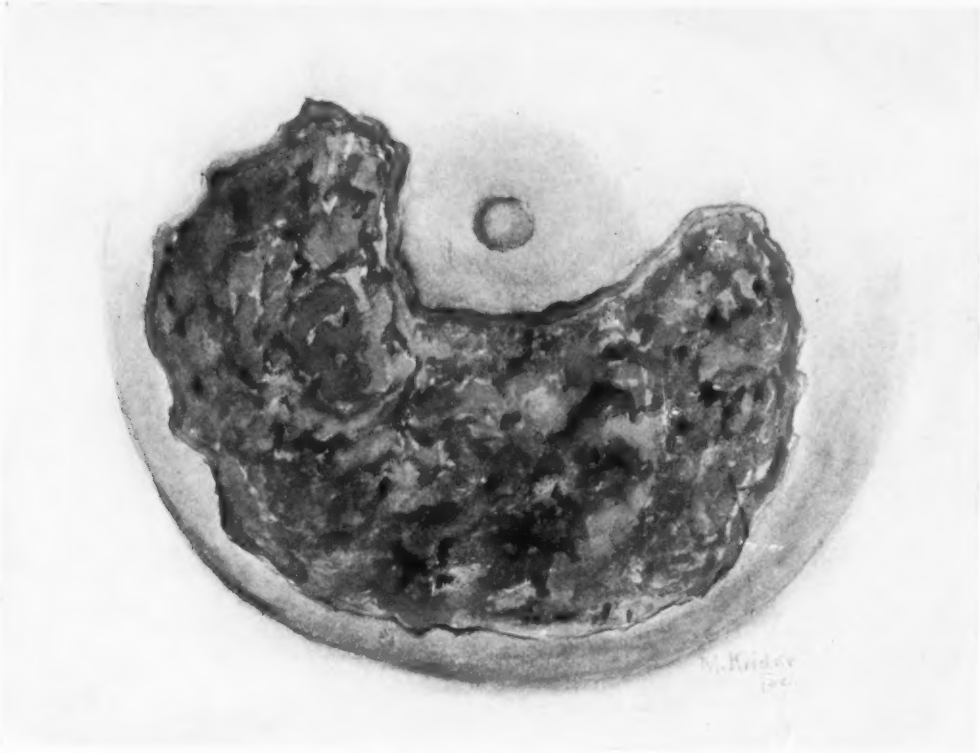
Mrs. J., aged 20, admitted to the Pittsburg Hospital December 17, 1906. Family history negative.

*Previous history.*—Delivered of a healthy child three weeks ago after a normal labor. Puerperium apparently normal until about one week ago, when child refused to nurse, and patient noticed that both breasts were enlarged, painful, and tender to touch. Nursing stopped. In a few days a small surface appeared on each breast just below the nipple, which was extremely tender and painful and which spread with great rapidity. The leaves of some plant were applied to both surfaces.

*Present condition.*—Skin of face a peculiar yellow color, with bright, flushed cheeks, pupils contracted, tongue dry, tremulous, and coated in patches; lungs, broncho-vesicular breathing over anterior surface both sides, with few moist râles; respiration 62; heart, both sounds weak, first sound seems somewhat blurred, very rapid, slightly irregular; pulse 140, slightly irregular, fairly good volume, not compressible; abdomen negative; pelvis negative; temperature 104° F.

*Breasts.*—Both were the seat of extensive ulceration of an irregular horseshoe shape, with the nipples in the centre. (Figure 1.) The ulcers measured approximately 20 cm. from side to side and 10 cm. from above downward and were scarcely more than 1.5 cm. deep at any point. The edges were sharp, gnawed out and undermined, the surfaces covered with dirty, grayish, sloughing tissue, with but little discharge—a typical picture of phagedenic ulceration. The process had attained its present dimensions in four days. The glandular tissue proper of the

FIG. 1.



Phagedenic ulceration of both breasts.

breasts was soft and presented no evidence of any inflammatory involvement.

Smears and cultures from the ulcers showed a mixture of staphylococci, streptococci, and pneumococci. A blood culture revealed the presence of staphylococci and a gram negative bacillus resembling the bacillus typhosus. The leukocytes upon admission were 15.200; two days later 9.600. Urine 1007, albumin present, granular casts.

The ulcers were thoroughly cauterized with pure bromine, which stopped the process at once. The accompanying plate gives a fair idea of the appearance of both breasts several days after cauterization and after the separation of most of the sloughing base. It is worthy of note that the areola surrounding the nipples appeared to offer a more effective barrier to the spread of the disease than other portions of the skin, as shown by the shape of the ulcers. The patient failed rapidly and died January 4, 1907, from toxic nephritis and diarrhœa. It is regretted that no autopsy was permitted.

# CUTANEOUS HORNS.

A REPORT OF THREE CASES.

BY CHARLES K. ROYS, M.D.,

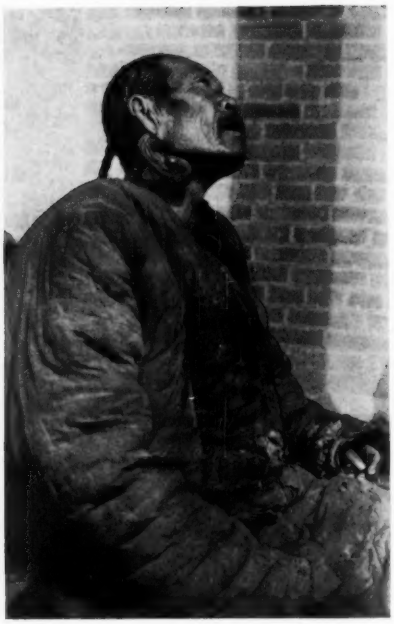
OF WEIHSIEN, CHINA.

THESE cases seem worthy of notice, not merely as surgical curiosities, but as giving some light on the connection between horns of the skin and epithelioma. In one case at least of those here given (No. II), the two processes of horn-production and extension of an epitheliomatous ulcer, could be seen going on side by side. Any reference to the etiology, pathology, or general literature of this subject would be superfluous so soon after the excellent article in ANNALS OF SURGERY, June, 1906, by Nietert and Babler of St. Louis. So the present writer will confine himself to the simple clinical report of his cases.

The fact that these cases occurred in native Chinese does not prevent their having a bearing on the problem stated above. Nor does the fact that all three cases were seen within six months time, indicate that this trouble is especially common among the Chinese. Practitioners of long experience in China tell me they have never seen a case. This may be said, however, that such cases go untreated much longer here than in countries where medical and surgical aid is more readily accessible, so that end-results of pathological conditions are more often seen.

CASE I. *Cutaneous Horn Lobe of Right Ear. Excision.*—A man, aged 67, had from childhood a small, warty mass on the back of the lobe of his right ear. It grew slowly till he was over 50 years of age, but for the past 12 years it has been growing more rapidly, producing a hard, painless projection, often cut off by the patient with a knife. Two years before admission, it fell off leaving a rough, irregular base, about 1 inch in diameter. In two years it grew again to its present size. It caused pain

FIG. 1.



Cutaneous bone of auricle.

when pulled or moved, so that the patient carried it suspended in a cloth bag, which hung from his ear.

On examination the man appeared fairly well-nourished and healthy, with nothing abnormal except the above-mentioned horn. This was a black, moderately hard projection, hanging loosely from the lobe of the right ear and the adjacent skin over the mastoid process. It was attached to the skin only, and had stretched the lobe of the ear to a length of about two inches. It was curved like the letter J, measuring 9 inches around the curve and 2½ inches in circumference at the base. Its surface was smooth and moderately hard; near the base it was rough, with longitudinal grooves and striations partly filled with sebaceous matter and dirt, not having been washed in the two years of its growth. The skin at the base was red and tender, with no ulceration, but with fleshy projections ½ inch in height, close around the base of the horn, which was slightly separated from these projecting papillæ and from its base on one side. No lymphatic enlargement (Fig. 1).

*Treatment.*—Excision under cocaine anæsthesia, cutting off the redundant lobe of the ear, and going through healthy skin, ¼ inch wide of the base of the horn.

*Note.*—The longest horn referred to by Nietert and Babler was in Soubervielle's case, with a length of 10 inches. The rate of growth is not stated. In Case 1 of this series the horn grew 9 inches in two years.

Case II. *Cutaneous Horn of the Lip, Becoming Epithelioma. Excision of ¾ of lip, and Right Submaxillary. Lymphatics.*—A man 60 years of age had for 20 years a hard painless mass growing from his lower lip, just to the right of the median line. He gave no history of syphilis, traumatism or other possible cause. When the mass grew large enough to interfere with eating, he would cut it off with a razor. He estimated that he had cut off about 2 inches in this way. He was a constant smoker of a long pipe with a metal mouth-piece, which he always held on the left side of his mouth, to avoid the growth. For the last two years he noticed a lateral growth of the mass across his lip, to the left, in addition to the longitudinal growth of the horn. The lateral growth was painful on pressure, and sometimes the seat of spontaneous shooting pains. It was usually covered with a crust, and sometimes bled.

On examination the man was found in fairly good condition, with the exception of his lower lip. On the vermillion border of the lip, just to the right of the median line, is the small, truncated, horny mass mentioned above, about the size of a navy bean; its surface rough and cracked, the skin around it hardened and infiltrated, especially to the left along the free margin of the lip, which is involved to the left angle of the mouth in an ulcer with a hard nodular base, rough necrotic surface, and slight purulent discharge. At the anterior margin of the ulcer, beginning in the median line, and extending ¾ of an inch to the left, is a low palisade-like projection of horny tissue, about as thick as a finger-nail and ¼ of an inch high, of a shiny yellow color, and showing fine vertical striations like those seen on the finger-nails. According to the patient's account, the growth of this has proceeded pari passu with the growth of the ulcer across his lip. Submaxillary and cervical lymphatics not enlarged.

*Treatment.*—Under chloroform anæsthesia, the entire contents of the left submaxillary triangle including the platysma were excised en masse. The wound being closed and protected, the left ¾ of the lower lip was excised, the defect being filled by a square lateral flap from the left cheek, procured by two horizontal incisions after the method of Malgaigne. The sutures were two of silver wire including the thickness of the lip; deep interrupted silk for the skin surface, and interrupted iodine catgut for the mucous membrane. The patent made an uneventful recovery.

*Note.*—Paget's case (loc. cit.) showed "spur-shaped sharp-pointed projections about the base of the ulcer" (a soot-cancer). This case (No. II), showed unmistakable horny tissue as part of an epitheliomatous extension from a primary focus of horn. I regret to say that the specimen was lost, and that the opportunity for histological examination was lost with it. It was also impossible to get a useful photograph with the small camera at the writer's command.

CASE III. *Multiple Cutaneous Horns of Glans Penis. Amputation.*—A man 26 years of age had from childhood a growth on the right side of the glans penis. His habits were good, and he was effectually protected from venereal disease, as intercourse was made impossible by the growth. He first noticed a small pimple, which became a wart-like mass, and gradually multiplied itself spreading over the right side of the glans penis until there

were about 25 small, hard, horny projections. The upper ¼ of the mass grew much faster than the rest, forming a long, curved, finger-like projection, which he cut off repeatedly with a knife because it caught in his clothing. He estimated the total growth at about 3 inches. The whole mass was painful if rubbed or struck. It did not interfere with micturition, but quite prevented intercourse. As it is the duty of every Chinese to acquire male descendants, he sought treatment to remove this disability.

On examination he was found to be a healthy, powerful man, normal except for his genital organs. The right half of the glans penis was occupied by a rough nodular mass. The upper ¼ of this mass was in the shape of a truncated pyramid, ¾ of an inch square at the base, and about 1 inch high, showing longitudinal striations at the sides and a smooth, cut surface at the top about ½ inch in diameter. Below this, and bounded by the sulcus, were 25 or 30 wart-like projections, hard and horny, and embedded in a crust from the ulcerated surface around and between them. These are limited to the right side of the glans, except one which lies just to the left of the frænum, below the meatus. The mass rests on a base about ⅓ of an inch thick, indurated and firmly fixed to the tissues of the glans. Lymphatics in both groins enlarged slightly tender, soft and movable.

*Treatment.*—Amputation of glans penis, leaving corpora cavernosa almost entire, and dissecting out urethra through glans almost to the meatus. Urethra split for a short distance on its under surface, and margins united to skin by silk sutures. Recovery was uneventful.

*Note.*—In Bellamy's patient (loc. cit.) "the horn grew from the clitoris and resembled the claw of a lion." Size not mentioned. In this case the horn, growing from the analogous organ, reached a total length of at least 3 inches. The uncleanly habits of the Chinese may help to account for frequent disease of the glans penis. In the six months since opening the hospital of which the writer has charge, there have been seen frequent soft and phagedenic chancres, three cases of carcinoma, and one of actinomycosis of the glans and prepuce.

# TRAUMATIC HEMATOMYELIA,

WITH A REPORT OF A CASE.

BY MILTON R. BARKER, M.S., M.D.,

OF CHICAGO.

HEMATOMYELIA is a term applied to a hemorrhage that takes place within the substance of the spinal cord. It is always intra medullary. That we should fully understand this condition, we should briefly review the anatomy of the blood supply of the cord. The blood is supplied by three main arteries and their branches, one anterior and two posterior spinal arteries, all three of which are branches of the vertebral; they are given off from the vertebral near where these join to form the basilar. The two anterior spinal trunks unite in a single artery in front of the medulla, which extends the entire length of the spinal cord in front. It is imbedded in the pia mater and lies in front of the anterior median fissure. The two posterior spinal arteries pass from their origin to the postero-lateral borders of the medulla and proceed separately the whole length of the spinal cord, being located just behind the posterior nerve roots. These arteries are also imbedded in the pia mater. The spinal arteries receive accessory branches along their course from the thyroid, intercostal, lumbar and ilio-lumbar arteries, through the intervertebral foramina, and give off numerous branches to the substance of the cord, through which the cord receives its vascular supply. As before noted, both the anterior and posterior spinal trunks are imbedded in the pia mater, hence are external to the cord. Therefore all hemorrhages that may take place from these trunks will not produce hematomyelia. If the rupture in the arterial wall is so located that the bleeding takes place into the subarachnoid space, hematomyelia does not result. In other words, the hemorrhage must take place in such a manner that the cord substance is invaded by it to produce hematomyelia. In hema-

tomyelia the damage is usually wrought in the gray columns of the cord, these offering the least resistance to the flow of blood, yet in some cases in which the hemorrhage is profuse the white tracts are invaded, but in these cases the blood does not follow the white tracts for any considerable distance, the axones acting as a barrier to its progress.

The ætiological factors in the production of hematomyelia are diseased conditions of the arterial walls; for instance, arteriosclerosis or conditions due to specific disease and traumatism. The former may be present, the latter is always present. The hemorrhage may be in the traumatic area or remote from it, the latter usually prevailing in uncomplicated cases. When the hemorrhage takes place in the traumatic area, the bony wall of the spinal canal is either crushed and splinters of bone pierce the substance of the cord, or it is pierced by knife or bullet wounds. In these cases much damage is wrought to the bony wall, membranes of the cord, and the cord itself, and the hematomyelia thus produced is only a part of the general destruction. While hematomyelia exists in these cases, it is not that uncomplicated form the symptoms of which are at times obscure and the diagnosis difficult, nor that form which we wish to emphasize in this paper.

The form of hematomyelia with which we are dealing takes place in the cervical cord, remote from the traumatic area, and usually follows the violence immediately, but may be postponed for several days or weeks. Its constant site in this class of cases being the cervical region, by reason of the fact of the great mobility of the spinal column in this region. Traumatisms applied to the nates, by falling, or by being struck by ponderous bodies, or applied to the lumbar or dorsal regions producing a sudden exaggerated extension or flexion of the cervical spinal column, may rupture either the anterior or posterior spinal arteries, by over-stretching or by forcibly dragging them against the bony wall of the spinal column. If the arterial walls are diseased the chance for their rupture is greatly enhanced. The traumatic insults in this class of cases may be severe, or so slight as to escape detection by external

appearances. In those cases in which the hemorrhage immediately follows the injury, the walls of one or more of the arteries are completely ruptured, but in that class of cases in which the hemorrhage takes place at some rather remote time, as several weeks or two months after the injury, it is probable that at the time of the injury, while the walls of the arteries are not completely ruptured, that their coats are so injured that they later give way, or perhaps only the intima-vasorum is ruptured, an aneurism following, which later ruptures producing the hematomyelia. I believe the above is a reasonable solution of these postponed hemorrhages. These vessels at the point of rupture are subjected to considerable blood pressure, being in quite close proximity to the heart.

As before noted, the damage to the cord is usually confined to the gray columns, and may be much or little according to the amount of bleeding. If the hemorrhage is considerable it will push its way through the gray columns for a distance of three or four segments of the cord above and below the bleeding point. Should the hemorrhage involve the third, fourth and fifth cervical cord segments, serious results will follow, the nerve centres of the phrenic being involved and paralysis of respiration resulting. In the form of hematomyelia of which we are speaking the upper extremities, and the rest of the body below the lesion, will be more or less involved and more or less permanently involved, according to the amount of bleeding that has taken place into the cord.

These hemorrhages may be divided into four categories as follows; local, profuse local, disseminated, and profuse disseminated. The neuroglia tissue in the gray columns of the cord offers greater resisting force to the flow of blood in some cases than in others. Hence in those cases where there is a marked resistance by this tissue, the blood does not make channels between the fibres of the neuroglia tissue and become disseminated through the gray columns, for the distance of a number of cord segments, but pushes the neuroglia tissue from it on all sides, stretching and breaking down its fibres and thus forming a pool of blood or perhaps several pools, which

pools form clots, that occupy more or less completely the gray columns for a space of perhaps three or four cord segments in close proximity to the bleeding point. The pressure of these clots upon the delicate tissues of the neurons, causes softening and destruction of them. When the mass of blood clot, and dead neurons is absorbed, cavities are left in the cord substance, and the functions of that part of the system presided over by these nerve cells and axones are permanently lost. These cavities in the cord later fill up with connective tissue. The larger the clot the greater will be the destruction of nerve tissue and the greater the loss of function. A small local hemorrhage may produce little or no permanent damage, while a profuse local hemorrhage, will cause permanent loss of function over a large area of the system. In the disseminated hemorrhage the blood makes its way between the neuroglia fibres and about the cells in the gray columns, permeating the substances of these columns for a distance of eight or ten cord segments, but pools of blood do not form, hence there are no clots to produce pressure and destroy nerve tissue. Hence permanent loss of function does not follow this form of hemorrhage, while in the profuse form of disseminated hemorrhage, clots form throughout the disseminated area, and produce pressure on the nerve cells and axones, causing softening and destruction of them, and when these small masses are absorbed numerous small cavities are left in the cord substance, and permanent loss of function occurs over numerous areas of the system more or less remote from each other.

Some of the important things to be remembered in connection with hematomyelia are first, profound general conditions that may follow apparently slight traumatisms applied to the spinal column in such a way as to cause extreme extension or flexion of the cervical segments of the cord. Second, profound conditions involving the cervical cord, due to traumatic insults perpetrated at a distance remote from the cervical region. Third, the cord lesion may appear many days or several weeks after the traumatic insult is received. Fourth, if the hemorrhage is profuse and local, permanent damage to

function will result to large contiguous areas in both upper and lower extremities, while if the hemorrhage is profuse and disseminated, permanent damage to function will result in many areas, in both upper and lower extremities more or less remote from each other. If the hemorrhage is small and local, or slight and disseminated, no permanent damage to function will result. Fifth, all forms of hematomyelia improve for about eighteen months, after that little improvement may be expected. Sixth, a guarded prognosis should always be made.

As to the diagnosis of this condition we have no means at our command for making anything more than a probable diagnosis of hematomyelia. Lumbar puncture in suspected cases has been advocated, but as a matter of fact is worse than useless. If blood should be found by this measure in the cerebro spinal fluid, it would not be of diagnostic value, as it would only prove that hemorrhage had taken place into the subarachnoid space, the only portion of the spinal canal, normally occupied by cerebro spinal fluid.

In a hypothetical case, in which paralysis of a portion of the upper and lower extremities, followed immediately a traumatism to the spinal column, remote from the cervical region, the paralysis increasing in extent and severity for several hours after the violence, without cranial nerve involvement. In a youthful patient free from disease, we would be justified in making a diagnosis of hematomyelia, but even in such a case we would think of hysteria as a possible cause of the condition, while in another case less clear, we would have to consider the possibility of scattered foci or morbid tissue changes in the cord due to latent degenerative changes, which have become active by reason of the traumatic insult. As a rule, however, the difficulties are greater in making diagnosis in real cases than in the hypothetical ones. Nevertheless with disseminated inhibition of physical function, in the upper and lower extremities, with increased reflex activity, and exaggerated tremors, following traumatism to the spinal column, more or less remote from the cervical region with no cranial

nerve involvement, a diagnosis of hematomyelia is the most probable. If the symptoms of hematomyelia do not appear until a time more or less remote from the date of injury, differential diagnosis is more difficult, for the reason that more time has been provided in which latent degenerative conditions may become active. Even after the lapse of eighteen or twenty months, we may not be able to decide positively what was the true condition.

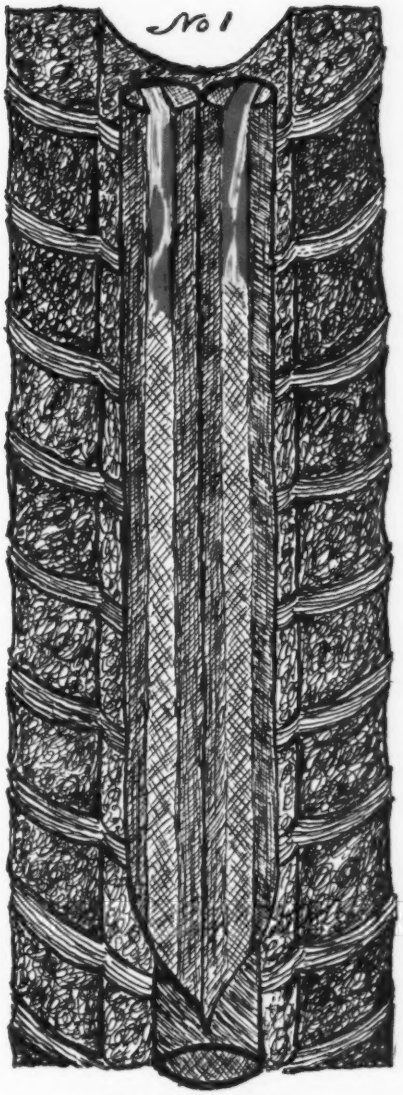
In slight hemorrhages either local or disseminated the patient will completely recover. The same result will follow hysteria as a rule, hence complete recovery does not decide for hematomyelia. In profuse hemorrhages the patient will improve for a time, but never fully recover. The same may occur in degenerative conditions. Hence we believe in a majority of cases we will not be able to make anything more than a probable diagnosis of hematomyelia, either at the beginning or end of the case.

The following illustrates a probable case of hematomyelia, the hemorrhage being postponed, profuse and local.

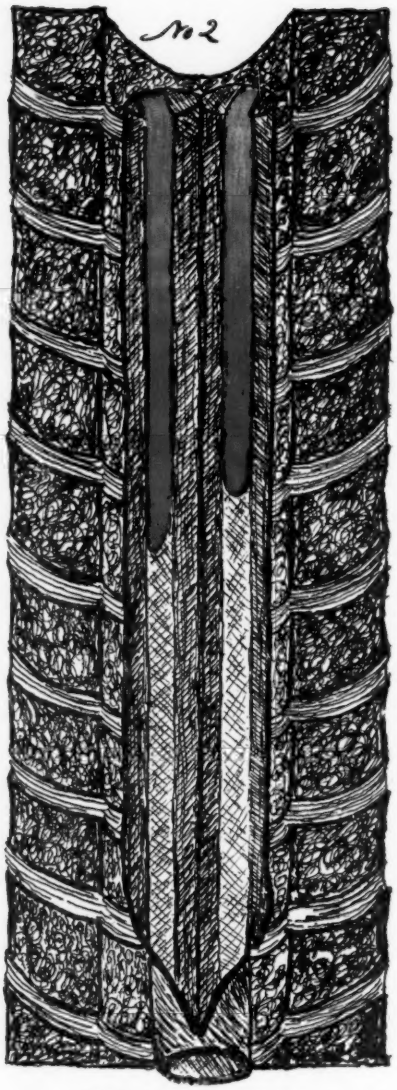
Mr. J., aged 33 years, teamster by occupation, denies having had any venereal disease or illness of any kind. Patient was thrown from his wagon striking his back, a little to the left of the spinal column, on the curbstone, sustaining a fracture of the seventh and eighth ribs near the column. I saw this patient a few moments after the injury occurred. The fractured ribs were cared for in the usual manner. The patient made a rapid recovery and in six weeks resumed his duties as teamster. Eight weeks after the injury, while caring for his team, preparatory for the day's work, suddenly and without warning, his lower limbs gave way and he settled down in a bunch on the barn floor. Two neighbors who happened to be present tried to assist him to his feet, but found that he had lost the use of both upper and lower extremities. He was perfectly conscious, could talk without difficulty, and knew all that was going on about him. His friends carried him into the house and put him to bed. I saw the patient a half an hour later. Sensation and motion were lost in the entire right lower limb, so profound was the condition in

this limb, the patient could not tell where it was unless he could see it. Motion was lost in the left lower limb below the knee and greatly impaired above the knee, but not entirely lost. Sensation in this limb was not completely lost, patient could tell when his left limb was moved and would respond to the prick of a pin. The right arm was paralyzed over the areas supplied by the musculo spiral, median and ulnar nerves, while the left arm was paralyzed over the areas supplied by the musculo spiral and median nerves. There were none of the cranial nerves involved, and the functions of micturition and defecation were at no time involved. Some little improvement in sensation commenced in the area supplied by the ulnar nerve three months after the paralysis occurred. Two months later both arms commenced improving over the entire areas involved. At the end of six months some improvement commenced in the lower limbs. Sensation began to appear in scattered areas over the right leg. At the end of twenty months the patient was able to use his arms in a manner —he could feed himself and partially dress himself, and use a cane in each hand. He had also regained the use of his limbs, so that he could walk in a way. He had better use of the limbs above than below the knees. He walks by raising the limb above the knee and then swinging the lower limb forward. It has now been about thirty-four months since the injury, but there has been no improvement for fourteen months. At the time of the injury the patient weighed 180 pounds. Six months later he weighed 120 pounds and at the present time weighs 140 pounds, but has not gained any in weight for a year. The knee jerk is exaggerated at the present time, while the Argyle-Robertson pupil and Romberg's sign cannot be demonstrated. This patient has never suffered pain, has never had a rise of temperature, and the pulse and respiration have always been normal. Neither has there at any time been tenderness anywhere along the spinal column, or any discoverable abnormality connected with it.

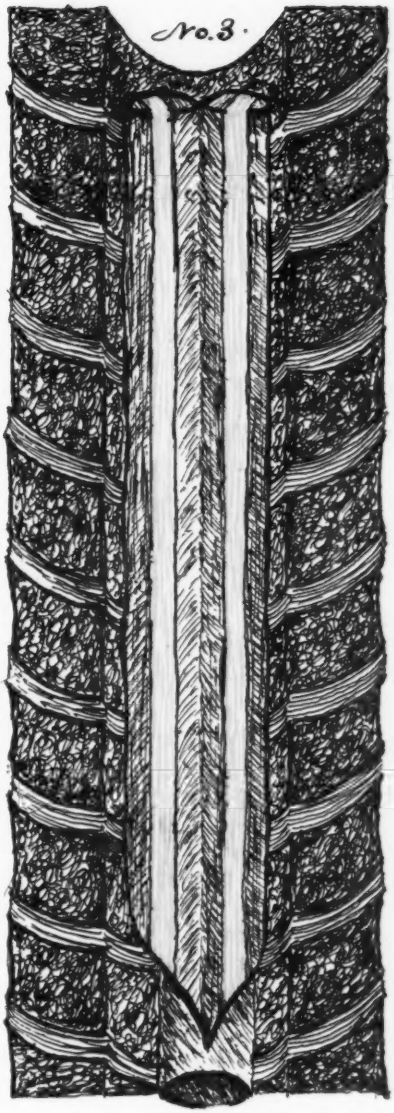
It is impossible for us in this case to positively associate the traumatism with the hemorrhage that occurred at so remote a period. We are well aware that hematomyelia occurs sometimes without traumatism, but in such cases the arteries are diseased. In the case presented there are no evidences of dis-



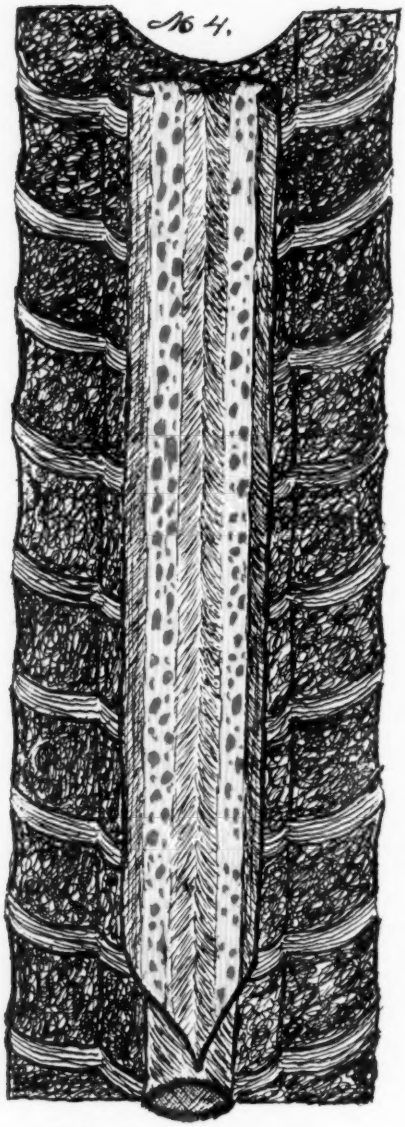

Slight local hemorrhage.




Profuse local hemorrhage.




Slight disseminated hemorrhage.




Profuse disseminated hemorrhage.

ease. We may regard the case from two view points: Was the hemorrhage due to the traumatism, or did it occur independently of it? In other words, would this patient have had his hemorrhage if he had not received the injury? Which is the more reasonable of the two conditions? To me, the former is overwhelmingly impressed as the true one.

It is only comparatively recent that hematomyelia has been recognized as a pathologic entity. For many decades it was one of that group of unknown conditions (except symptomatically) known as railway spine. How many conditions were contained in this group is not known, but it is certain that one of the most important of the group was removed from it when hematomyelia was identified and placed in a category by itself. We now find ourselves facing a new danger; that nearly all cases that were once known as railway spine are now placed, or in danger of being placed, in the category of hematomyelia. As a precaution against this, we can do no better than quote from Leube. "The diagnosis of spinal apoplexy should only be made with the greatest reserve. The sudden onset of the disease, the apoplectiform appearance of paralysis, the most important support for the diagnosis, are also noted in other affections of the cord, especially now and then in acute myelitis. Only when certain etiological conditions simultaneously are in favor of the diagnosis of spinal-cord hemorrhage; a fall, a severe blow upon the back, fracture of the vertebræ, the existence of a marked hemorrhagic diathesis or of a atheroma; a little more certainty in the diagnosis is permissible."

The drawings, Nos. 1, 2, 3 and 4, illustrate a section of the spinal column, with a portion of the arch of each vertebra removed, revealing the cord in the spinal canal. The cord is laid open at the posterior median fissure and each side turned half over showing the hemorrhage in the gray columns in each side of the cord.

# NERVE DISASSOCIATION; A NEW METHOD FOR THE SURGICAL RELIEF OF CERTAIN PAINFUL OR PARALYTIC AFFECTIONS OF NERVE TRUNKS.*

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OF PHILADELPHIA,

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*Summary.*—The following is a preliminary report giving the results obtained in treating certain forms of paralysis or paræsthesia due to injury or inflammation of nerve trunks by isolating the affected part of the nerve through an incision, freely opening the nerve sheath, disassociating the component fibers, and isolating the nerve from later fibrous tissue compression. The neurolysis is intended to permit the escape of exudate from within the nerve sheath, to reduce pressure upon individual nerve fibers; to free axis cylinders which have become useless through entanglement in scar tissue, to facilitate the formation of new or the restoration of old nerve paths, and to stimulate desirable trophic changes in the nerve trunk.

The influence of pressure within the nerve sheath as a cause of palsy and anæsthesia was brought to our notice in November, 1905, by a patient who had sustained a small incision of the median nerve from a piece of flying glass. On exposure of the injured nerve it was found that the nerve was not divided, but was the seat of a marked fusiform enlargement. Upon incision of the affected area there flowed from between the nerve fibres a gelatinous and serous fluid. In this patient nothing was done except to make a free longitudinal incision into the nerve. Four days later, upon testing the hand it was found that the area of anæsthesia had decreased

* Read in part before the Northeast Branch, Philadelphia County Medical Society, February 18, 1907.

one-third and that there was a distinct increase in the ability to flex the fingers. The prompt improvement in this patient was very suggestive, and later we gradually developed a method of treating certain forms of neuritis that have produced paresthesia or paralysis and also a possible means of inducing regeneration along nerve paths blocked by areas of cicatricial tissue. Unfortunately, our experience with this new operation, while encouraging, has been limited to four cases, and this preliminary report is made, therefore, with the hope that a wider application may more precisely determine its field of usefulness.

*Technique of the Operation.*—After sufficiently exposing the affected nerve through an incision, the nerve is isolated from adjacent tissues and a free longitudinal incision of the nerve sheath made. The sheath should be divided, if possible, well beyond the limits of the lesion. The nerve trunk is then lifted upon one or two fingers, held taut, and the nerve fibers carefully separated from each other by means of a small, sharp tenotome. Care is taken to divide as few nerve fibers as possible, although it is aimed to freely separate the nerve fibers from each other. As the nerve fibers become separated, the nerve is transformed from a rounded cord to a flat ribbon-like band of separated fibers. If cicatricial tissue is encountered in the nerve trunk the separation of the fibers is prolonged along straight lines dividing the scar into multiple parallel threads of tissue. Having freely disassociated the nerve fibers, if the nerve were previously imbedded in cicatricial or fibrous tissue it should be removed from this area, or at least isolated from future cicatricial adhesions by the interposition of adipose tissue, strips of which can usually be secured from beneath the skin. In one of our cases, the musculo-spiral nerve was transplanted from the musculo-spiral groove into the subcutaneous fatty tissue. In two other cases we have laid thin strips of adipose tissue between the nerve and its normal bed. Of seven cases in which we have partially or thoroughly disassociated nerve fibers, in only one were we able to detect an increase of the paralysis immediately following the operation, while in

several there was an almost immediate increase of function in the affected nerve field. In three instances the nerve trunks were split for purposes of nerve transplantation. During the operation it is important that the nerve be handled gently, be not subjected to strong traction, and that the knife be sufficiently sharp to separate, without unnecessarily pulling, tearing, or bruising the nerve fibers. Theoretically, it may be assumed that the operation may be of benefit in a number of ways as follows:

FIRST. *The relief of tension within the sheath.*—The free disassociation permits the immediate escape of interfibrillar exudate. The pressure of the constricting nerve sheath is relieved, intraneural collections of fibrous tissue are divided and constricted nerve fibers freed. This is well shown in Case I.

SECOND. *The operation may be useful in permitting a rearrangement of nerve paths.*—In the process of disassociation it is inevitable that many axis cylinders will be divided or torn free from their connections. Thus there is left along the tract of the operation, numerous free ended axis cylinders in condition to form new anastomoses with a possibility of the reëstablishment of many nerve paths previously interrupted. For example, in brachial birth palsy, or after traumatic division of nerves, the divided nerve fibers may become entangled in the new forming connective tissue and remain buried and incapable of function. In the process of disassociation these nerve fibers are freed from their entanglements, divided, and are left adjacent to other divided fibers, with some of which they may anastomose, reëstablishing the function; or again, other divided short segments of nerves may by forming attachments at each end serve as bridges over the gap caused by the injury.

THIRD. *The operation may facilitate the bridging of cicatricial gaps in nerves.*—If a nerve has been divided and the ends finally joined by a mass of scar tissue, say one-half inch or more in length, the separation and freeing of nerve fibers above and below the fibrous area, and the splitting of the

cicatricial connecting band into threads of tissue with innumerable interspaces between, should, theoretically, at least, place the freed axis cylinders in a most favorable condition for growth and ultimate anastomoses along the guiding trellis-like strands of fibro-connective tissue. It would seem that such a fibrillated fibrous bridge should give much better results than where the divided and separated nerve ends are bridged by catgut or other foreign material. Moreover, all residual nerve filaments are conserved and there is no sacrifice of nerve tissue such as occurs when the cicatricial area is excised or resected. While after primary nerve injuries the immediate exudate and hæmorrhage may be prejudicial to anastomosis; in nerve disassociation the field is practically free from blood, the opportunities for drainage are good and there should be little interference by the pressure of exudates.

CASE I.—*Partial division of the median nerve with localized infiltrative neuritis. Prompt partial return of function after incision into the nerve.*—M. G., 32 years old. Well nourished. Previous history negative. In September, 1905, a piece of glass from an exploding bottle of soda water made a short incision about two inches above and one inch internal to the line of the internal condyle of his left arm. This was followed by inability to flex the index and second fingers and anesthesia of the entire palmar surface and the terminal portions of the dorsal surfaces of the first two fingers. There was no paralysis of the thumb, and adduction and abduction of the fingers were retained. Two months later the patient had partially regained the power of flexion of the second finger. On November 22, 1905, the patient entered the Samaritan Hospital. The median nerve was exposed opposite the superficial scar. In this area the nerve showed a grayish, fusiform expansion of about three times the calibre of the normal nerve. This enlargement of the nerve trunk was freely incised in a vertical direction and a marked gelatinous and serous infiltration between the fibers found. The wound was closed in layers without drainage. Four days later the area of anæsthesia over the palmar surfaces of the finger was found to have decreased about one-third. He could partially flex the first finger at the knuckles, but not at the interphalangeal joint. After

this immediate improvement there was little change for ten months. Recently a progressive increase in power has been reported. In this case the thorough disassociation of fibers used in the later cases was not carried out.

CASE II.—*Progressive musculo-spiral neuritis following traumatism. Nerve-stretching; temporary relief from pain and complete palsy of musculo-spiral nerve. Nerve disassociation, with immediate partial return of motion and relief from pain, secondary return of some of the symptoms, and final progressive improvement.*

*History.*—A. S., 32 years old. (Patient of Dr. W. A. Steel.) Mill hand. Previous history negative.

*History of Neuritis.*—Six years ago patient fell from a bicycle bruising an area over the left musculo-spiral groove. Following the injury an intermittent neuralgia appeared in the field of the musculo-spiral nerve and continued for five years. Ten months ago the neuralgia became constant and there was a gradual decrease in the power of the extensor muscles of the forearm. Rest, counter-irritation, and internal medication failed to relieve the symptoms.

*Operative Treatment.*—In September, 1906, the patient entered the Samaritan Hospital, the nerve was exposed in the musculo-spiral groove (Dr. Steel), freed from its adhesions and stretched. Complete musculo-spiral paralysis followed the operation. The pain was relieved for a few weeks, but gradually returned with increasing severity. There was partial ability to flex the fingers and thumb (median and ulnar nerve), but this was impaired. Electricity and massage were used. Three months later, the pain continuing with great severity, the nerve was exposed (Drs. Steel and Babcock) over a distance of seven inches and it was found shrunken and grayish in color and adherent over an area one inch in length corresponding to the site of the injury. The nerve was isolated, the nerve sheath opened, and the nerve fibers freely disassociated from the upper fourth of the humerus to the elbow. The nerve was then lifted out of its groove between the heads of the triceps and transplanted into the deep subcutaneous fat. The immediate effect of the operation was relief from the pain and the ability to extend the fingers and wrist from the splint, indicating some restoration of the musculo-spiral function. About a week later there was a

partial return of the pain, and this continued for two months after the operation, when the nutrition of the hand and forearm having improved there was a gradual cessation of pain and return of power. Three months after the operation there was no pain in the peripheral distribution of the musculo-spiral nerve, but some tenderness and pain in the axilla and over the clavicle. Flexion, extension, and rotation of the hand and fingers are nearly perfect. Electricity and passive motion have been used, beginning two weeks after the operation. In this case the striking features are the immediate disappearance of the wrist-drop following the neurolysis; second, the return of pain and loss of power, probably from the exudate poured out during the reparative process, and the final relief from pain except in an area proximal to the field of operation.

CASE III.—*Intractable sciatica. Nerve-stretching followed by temporary relief from pain and complete palsy. Return of pain. Disassociation of posterior tibial nerve followed by partial return of motion in twenty-four hours and relief from pain in the field of the disassociation.*

*History.*—S. K., age 21, single. Factory girl. Previous history negative. Had suffered with neuralgic pains along the course of the left sciatic nerve for eight months not relieved by various constitutional and local measures, including injections about the nerve trunk. She had also been in one hospital for treatment for six weeks and in a second for one week. October 24, 1906, about eight months after the development of the pain, she entered the Samaritan Hospital, and the day following, under spinal anæsthesia by stovaine, the left sciatic nerve was exposed and thoroughly stretched. The operation was followed by immediate relief from pain and complete paralysis of the leg and foot. Six days later the patient began to complain of some return of the pain. As the pain continued and proved progressive, especially in the calf of the leg, on November 26, about one month after the first operation, the patient, under spinal anæsthesia by tropa-cocaine, was treated by exposure and thorough disassociation of the upper third of the posteror tibial nerve. The nerve was then insolated by strips of adipose tissue taken from under the skin and the wound closed in layers without drainage. Twenty-four hours after the operation there was ability to flex the toes one-fourth of the normal range. There

was wound soreness, but relief from the neuralgic pain; later there was some return of the pain in the foot, which subsided under hot baths, so that the patient is now nearly free from severe pain in the leg, although there are some pains about the upper thigh and hip. There is anæsthesia of the anterior surface of the foot and leg, while sensation is present over the posterior surface, and there has been a gradual subsidence of the paralysis. There was in this case, therefore, a partial but immediate return of function in the distribution of the nerve operated upon, which has persisted, while anæsthesia continues in the distribution in the anterior tibial nerve, the branch not treated by disassociation.

CASE IV.—*Intense neuritis of the forearm chiefly involving the field of the median nerve. Disassociation of median nerve followed by increase of paralysis, but marked relief from pain. Gradual resumption of power and increasing relief.*

Mrs. H. T., age 48, previous history negative except two attacks of typhoid fever about the age of puberty. A year ago, one month after moving into a damp house, she noted a sensation of coldness in the posterior surface of the left hand, between the thumb and index finger. The application of water would produce a chill. Increasing lancinating pains shooting from the tip of the index finger along the inside of the arm to axilla developed, with tenderness. The fingers became stiff, could be flexed only partially and at times not at all. The third and fourth fingers remained normal. The pain became so intense that for nine weeks preceding her entrance to the hospital, three hypodermics of morphine were injected into the arm daily. At the Samaritan Hospital, March 26, 1907, the lower third of median nerve in the arm, and likewise the lower half of median nerve in the forearm were exposed by a longitudinal incision above the elbow and one above the wrist, isolated, the nerve sheaths carefully divided and the nerve fibers thoroughly disassociated. Following the operation there was a loss of motion of the first two fingers and thumb, with a sense of marked anæsthesia. The pain was much less intense and the tenderness much reduced. There was some return of motion within a week. Three months after the operation the patient could sleep comfortably at night, had partial flexion of all fingers, some sense of anæsthesia, and increasing freedom from pain. Future experience may prove that it is unwise to disassociate two areas of a single nerve trunk at one time.

Of the four cases in which an operative disassociation of nerves was carried out, three were for painful conditions and these patients obtained marked relief by the operation. In all four there were paralytic symptoms and in three of these cases there was an immediate decrease in the palsy following the neurolysis. In the remaining case, one in which a single nerve was disassociated, along two different areas there was a transient increase in the paralysis. In two of the cases nerve stretching had previously been employed, had failed to give continued relief and had produced immediate palsy. For the present we may conclude:

*First.*—That the surgical disassociation of nerve fibers may be carried out without producing gross evidence of reduction in the conducting power of the nerve.

*Second.*—Disassociation probably is not as apt to produce paralysis as thorough nerve stretching.

*Third.*—That in certain cases of neuritis, nerve disassociation is less dangerous and more potent in relieving symptoms than nerve stretching.

*Fourth.*—In certain cases of motor paralysis following inflammation or injury of nerve trunks, disassociation may be followed by a remarkable and almost immediate return of some of the function.

*Fifth.*—In the treatment of certain forms of peripheral paralysis due to interruptions of nerve paths by masses of fibrous or other tissue, the operation of nerve disassociation from its apparent safety and conservatism is deserving of trial. Especially do we feel that it is warranted in cases of brachial birth palsy where no gross lesion is found in the nerve trunks or where extensive resections, anastomoses, or forms of nerve bridging by catgut or other foreign materials would otherwise be employed.

# OPERATIONS ON THE SPINAL COLUMN.*

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OF BALTIMORE, MD.,

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OPERATIONS upon the spinal column have been numerous, but they have been mainly for the purpose of getting within the spinal canal rather than as operative procedures upon the spine itself. The clinical picture presented by pressure on the spinal cord, whatever the cause may be, is always of the greatest interest. This, I fear, has more or less diverted our attention from a proper consideration of the external aspect of the column, and we have failed to realize that it is the seat of changes which demand operative interference. Consider for a moment the anatomical structure of the spinal column. How great is its length, extending as it does from the skull in its upper portion to the coccyx below, a distance in the average adult varying from 65 to 80 cm., or between two and two and a half feet. Think of the number of its component parts each a distinct unit and liable to the changes from trauma and infection as other bones of the human frame. Look at the great number of joints which are present, which are of two characters, both arthrodial and amphiarthrodial. While their individual amount of motion is extremely small as compared to many other joints of the body, nevertheless, they are prone to many of the changes which cause serious trouble in other articulations. Each individual vertebra is attached to its neighbor by five sets of ligaments, and these are peculiarly susceptible to certain forms of infection, as those produced by the gonococcus. The normal elasticity of the ligament is diminished and a semi-calcareous strand takes its place. After traumatism these ligaments may be pulled away from the vertebral bodies stripping off portions of the periosteum, and form exostoses

* Read before the American Orthopedic Association, May 9, 1907.

of greater or less dimensions. These exotoses may be anatomically situated so as to interfere with the normal motion of the spine and cause pain by impingement of the nerve roots as they emerge from the spinal column. The point of attachment of muscles or of tendons has always been a seat of injury following violent traumatism or strain. The periosteal covering of the bones at these points is injured and permanent damage is often done. When one considers the large number of muscles that are attached to the spinal column throughout its extent, and how very small is the surface of the vertebra free from such muscles, is it surprising that under constant strain which the continual motions of the spine necessitate that there are areas of lessened resistance, the starting point of future trouble? Consider again, the relation of the vertebra to important neurological structures, as the cervical, and lumbar plexuses, and the various intercostal nerves. How narrow is the lumen through which these nerves pass, and how closely are they pressed by the numerous ligaments which hold the adjacent vertebræ together! Proliferations of the edges of these inter-vertebral articulations press directly on them. The contiguity of the nerve elements to the bony structure of the spine offers opportunity for nerve lesions, which have in many cases been put down to a true inflammatory neuritis.

The radiograph has marked a distinct advance in our knowledge of the congenital defects in the spine, and of its numerous variations from the normal which often have a clinical significance. Spina bifida is well known. This is caused when the laminæ of a particular vertebra fail to coalesce. It presents, however, such gross external appearances that the radiograph was not necessary to determine its embryological origin. The small variations, however, resulting in most painful though often obscure symptoms have been brought to light only since the routine use of the X-ray. Thus far has our knowledge concerning the cause of symptoms referable to the brachial plexus been cleared up. Numerous instances of the presence of a cervical rib, or ribs, unilateral or bilateral, are now of such common occurrence that no further mention need be made of

them, but the fact that certain types of neuralgia are due to the pressure of the cervical ribs directly on the plexus has led to the excision of this anatomical variation with complete cure of that group of cases which has for so long a time defied therapeutic remedies. The cervical portion of the spine is the main location of the extra rib, but it is by no means confined to this area. Any of the lumbar vertebræ may possess a rib. Generally when this occurs it is the first lumbar vertebra which is involved and symptoms of pressure on the lumbar plexus result from it, and the cause of these symptoms would be almost impossible to make out unless a radiograph were taken. Any of the five lumbar vertebræ may possess such an appendage, and one of the cases which is the cause of this paper had an extra rib coming off of the fifth lumbar vertebra extending down into the pelvis and was densely adherent to the lumbar sacral cord. It produced a sciatica which defied all kinds of therapeutic treatment for years. Besides the presence of extra ribs other malformations are often met with. Indeed the spinal column has probably more variations from the normal than any other bony structure of the human body. Often the different centers of ossification of the body of the vertebra fail to fuse and the vertebral body remains in two parts between which there is a cleft going directly down to the spinal canal. At times the two sides of the vertebra differ materially in size. It is claimed by some that lateral curvature is due to this asymmetrical development. From Mall's statistics on the embryo one is surprised how often there is a variation from the normal in regard to the number of vertebræ present. Besides the variation in number Böhm before this society at its meeting last year pointed out that the ribs while the same in number on both sides of the spinal column were often asymmetrically placed, that is, the ribs on one side of the spine might often be one vertebral body higher than those on the opposite side. This leads to a great many variations in regard to body development. Instead of one rib springing from each side of the dorsal vertebræ two may come off of one side while one comes from the other. This confinement of two ribs within

a restricted space at their point of origin may cause both sensory and motor disturbances as they press upon the emerging nerves.

Trauma is another cause of certain conditions in the spine which at times necessitate operative interference for the alleviation of their symptoms. We operate on fractures of the spine in order to remove the fragments causing pressure on the cord or on the nerves after they have passed through the spinal column. A rupture of the ligaments and the tearing of muscles cause periosteal thickening and fibrous and bony enlargements which impinge upon neurological structures, or press so hard upon neighboring bony projections with the least movement of the spine that they must be removed before permanent cure will result. Another and probably the most important cause of changes in the spinal column where operation is indicated for the relief of symptoms is the various infectious processes and metabolic disturbances. The gonococcus is the organism most often found in the production of these changes. The organism probably attacks the ligament or the periosteum at the edges of the vertebra. The structures undergo the changes commonly seen in gonococcal infection, namely, fibrous thickening and at times calcification. If the periosteum is involved a true exostosis may be formed and the normal motion in the spine brings these exostoses in contact one with another, or with some projecting bony prominence so that a deep-seated pain is produced. Let me recite a case of gonococcal infection involving both feet as well as the spine.

CASE I.—C. C., age 26. Admitted February 16, 1905. Complains of pains in both heels and pain in the back.

*Family History.*—Negative.

*Previous History.*—Three attacks of gonorrhœa, the first ten years ago, the second three years ago, the third one year and three months ago. Associated with a posterior urethritis. With the second attack he had a suppurating inguinal bubo. No history of rheumatism, typhoid fever, or pneumonia.

*Present Illness.*—Began one year ago; that is, three months after his attack of gonorrhœa. It began in both heels simul-

taneously. The pain and soreness have continued ever since, but with increasing severity. Six months ago, while at Hot Springs for the pain in his feet, he was taken with a pain in his back. This pain is present, whether he lies down or is walking about. He walks with great difficulty.

*Physical Examination.*—Not a robust man. Loss in weight during the past year has been fifteen pounds. Right foot shows a decided thickening of the os calcis. At the attachment of the plantar fascia with the os calcis there is a spot of acute tenderness on pressure. This area measures about one centimeter. There are no acute inflammatory symptoms. Stretching of the plantar fascia causes the usual pain. The big toe joint is slightly enlarged. There is no pain on pressure about the tendo Achillis. The left foot is similar in all respects to the right. Spine painful to pressure along the entire lumbar region, but especially at the junction of the third and fourth vertebræ. Lumbar lordosis is slightly diminished. There is a slight bending of the body to the right. Some pain is referred to the right sciatic region. Hyperextension of the spine is impossible. Bending to the left is restricted more than bending to the right.

*Operation.*—Incision along the outer border of the os calcis was made. The exostosis was removed, and with it the tissue immediately adjacent. The plantar fascia was adherent to the underlying adipose tissue in places.

*Radiograph.*—Small exostosis at attachment of flexor brevis digitorum to os calcis. Slight thickening of os calcis. Radiograph of the back shows two exostoses approaching one another between the third and fourth lumbar vertebræ (Figs. 1 and 2).

*Bacteriological Report.*—Cultures were negative. Plantar fascia showed evidence of an acute inflammatory process, with round-cell infiltration and an increase in blood-vessels. Sections stained for organisms show the presence of a biscuit-shaped coccus, which is the size and shape of the gonococcus.

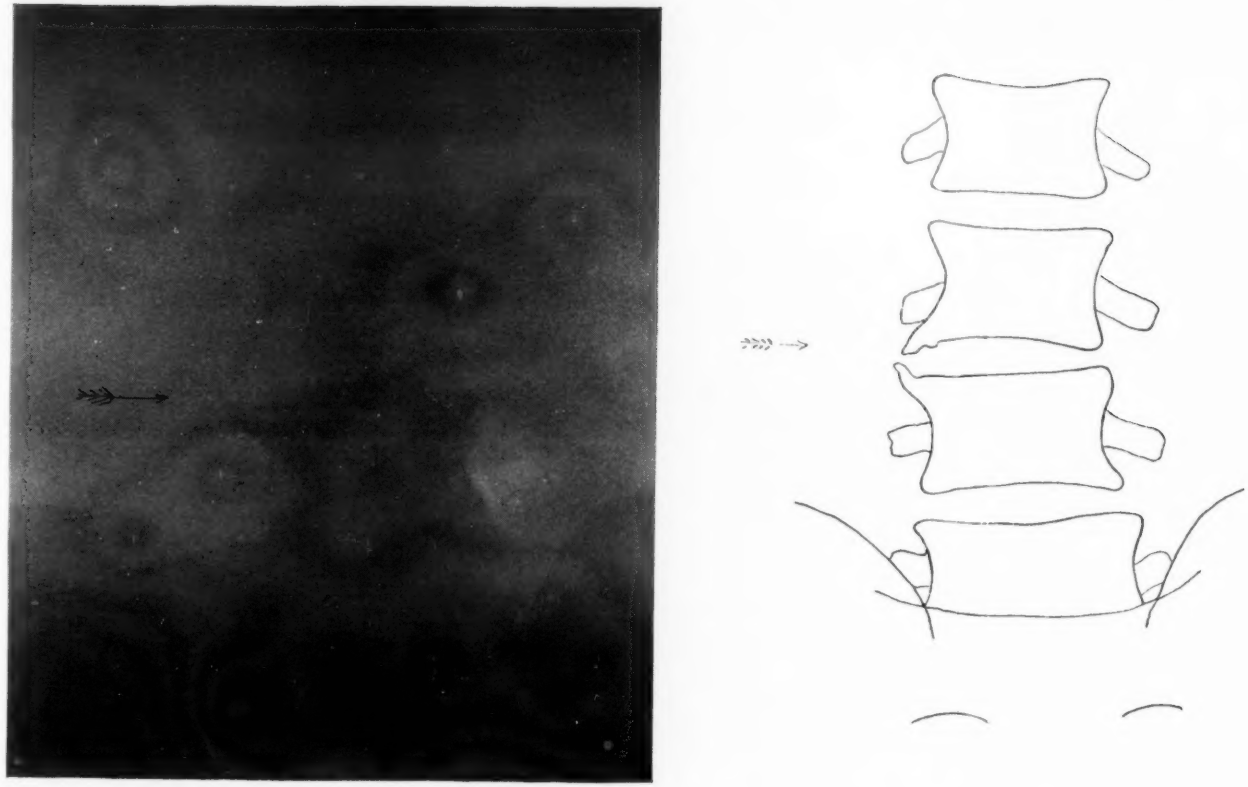
*Result.*—Three months after the operation, patient reports that the pain in his heels has entirely disappeared. He is still wearing a spinal support for the arthritis of the back. He is attending to his business for the first time in more than a year.

Here we have the production of an exostosis on the inferior surface of the os calcis, which when removed showed the

FIG. 1.

CASE I.—Gonorrhœal exostosis of os. calcis.

FIG. 2.



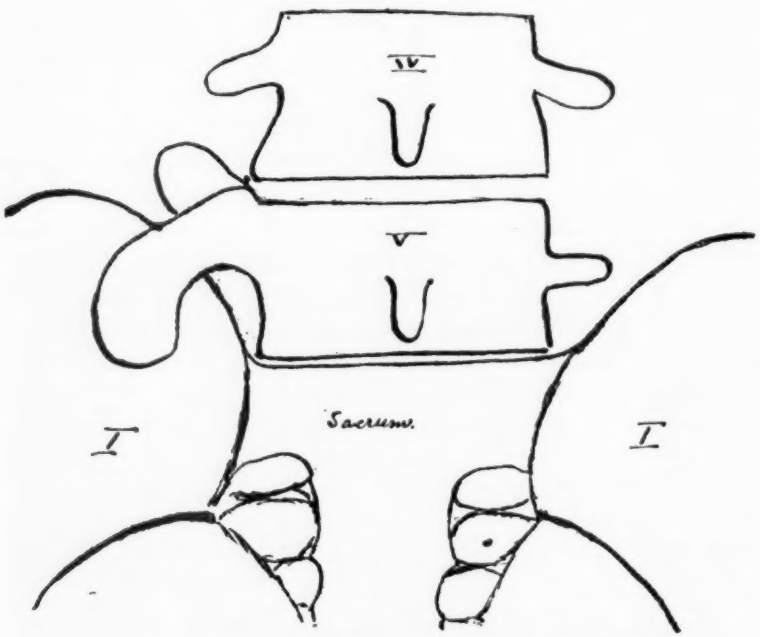
CASE I.—Gonorrhœal exostoses of the spine.

presence of the gonococcus in the tissue. The radiograph of the spine shows two prominent exostoses following the course of the lateral ligament. One springs from the inferior border of the third lumbar vertebra, and the other from the superior border of the fourth lumbar vertebra. As the spine undergoes lateral bending it is easily seen how these two exostoses come in contact one with another and produce the pain complained of. As the gonococcus was the organism found in the exostosis of the heel, and as the attack of pain in the back came on shortly following the trouble in the heel it is is fair to assume that it was also the etiological factor of the exostosis in the spine. As long as the patient wears a light support which prevents lateral motion in the lumbar region he is perfectly comfortable. As soon as he discontinues its use the pain returns. The rational treatment would be to remove these exostoses in the spine, but as the brace affords perfect relief the patient is loth to undergo further operative measures. Not only a gonococcus can cause such formations upon the spine, but also other organisms, as the tubercle bacillus and the typhoid bacillus, and the cases of both of these infections resulting in changes in the contour of the spine have been reported.

Besides those cases known to be of infectious origin we have the cases of osteoarthritis of the spine. These cases are probably due to metabolic disturbances. They may involve a large area of the column or there may be some localized focus which one can usually remove. They are generally found in the lumbar or cervical region, that is wherever a considerable degree of motion is allowed. Often these cases are associated with other constitutional disturbances, as the presence of gall stones, or of renal calculus. Unfortunately when the new bony deposits have been laid down they do not respond to medication as the two conditions just mentioned. I have brought up the subject to-day in order to show that whatever be the etiological factor in these cases, whether congenital deformities, anatomical variations, traumatism, infectious processes, or metabolic changes, the spinal column is a legitimate

field for operation in certain cases which can be definitely pointed out by means of the radiograph. No other treatment will produce satisfactory and permanent results. In this connection I should like to report two cases where operative treatment was instituted with perfect recovery of the patient. In the case which we will call No. 2 we have the presence of a rudimentary rib springing from the left side of the fifth lumbar vertebra. It passed down into the pelvis, was inti-

FIG. 3.




CASE II.—X-ray tracing, showing extra rib from 5th lumbar vertebra.

mately bound to the lumbar sacral cord and was the cause of a sciatica which had been so persistent and so severe that the girl had been practically an invalid for the past five years. This rudimentary rib was removed by operation and thereby the pressure on the nerve removed, and since that time she has been perfectly free from pain and goes about as any normal person. The history is as follows:

CASE II.—E. B., white, female; age 22, referred to me by Dr. Thayer on August 22, 1906, and was admitted to the Johns Hopkins Hospital. She complained of sciatica.

*Family History.*—Negative.

*Previous Illness.*—There were the usual diseases of childhood, with no acute illness.

*The Present Illness.*—Duration five years. There was gradual onset with excruciating pain referred along the course of the left sciatic nerve, going down as far as the foot. The pain was so intense that she was confined to her bed for nine months. Later she was able to be about on crutches. There would be periods when the pain was less severe than at other times, but it was always present to a marked degree. The pain became very much worse again seven months ago, since which time she has been practically confined to her bed, the least motion tending to aggravate the condition. All the usual remedies have been applied. The galvanic current has been used without effect. The leg has been packed in ice and also put in extension. Injections of chloroform have been made directly into the sciatic surfaces only to aggravate the trouble. Four years ago the uterus was suspended, thinking that it might possibly be exerting some pressure on the nerve in question.

*Physical Examination.*—She is rather a thin girl, somewhat anæmic, hæmoglobin being 79 per cent. There is no glandular enlargement. Heart and lungs negative. The abdomen is negative except for some soreness on pressure in the left side of the umbilical region. The patient lies in bed with the leg flexed at 45°. The knee jerks are slightly exaggerated. There is intense pain on pressure over the lower lumbar region on the left side and also over the sciatic nerve as it emerges beneath the gluteus muscle. The pain is elicited on pressure behind the trochanter as well as in the popliteal space. All motions of the leg are carefully guarded. As the patient cannot stand it is impossible to test the flexibility of the spine. There is an atrophy of the thigh of 2 cm. and 1 cm. of the calf.

*The Radiograph Examination.*—This shows a rudimentary rib about one and three-quarter inches in length springing from the left side of the fifth lumbar vertebra and going down into the pelvis. The rib is of unusual thickness. It articulates with the vertebra in a normal manner. The transverse process is seen pushed somewhat upward (Figs. 3 and 4).

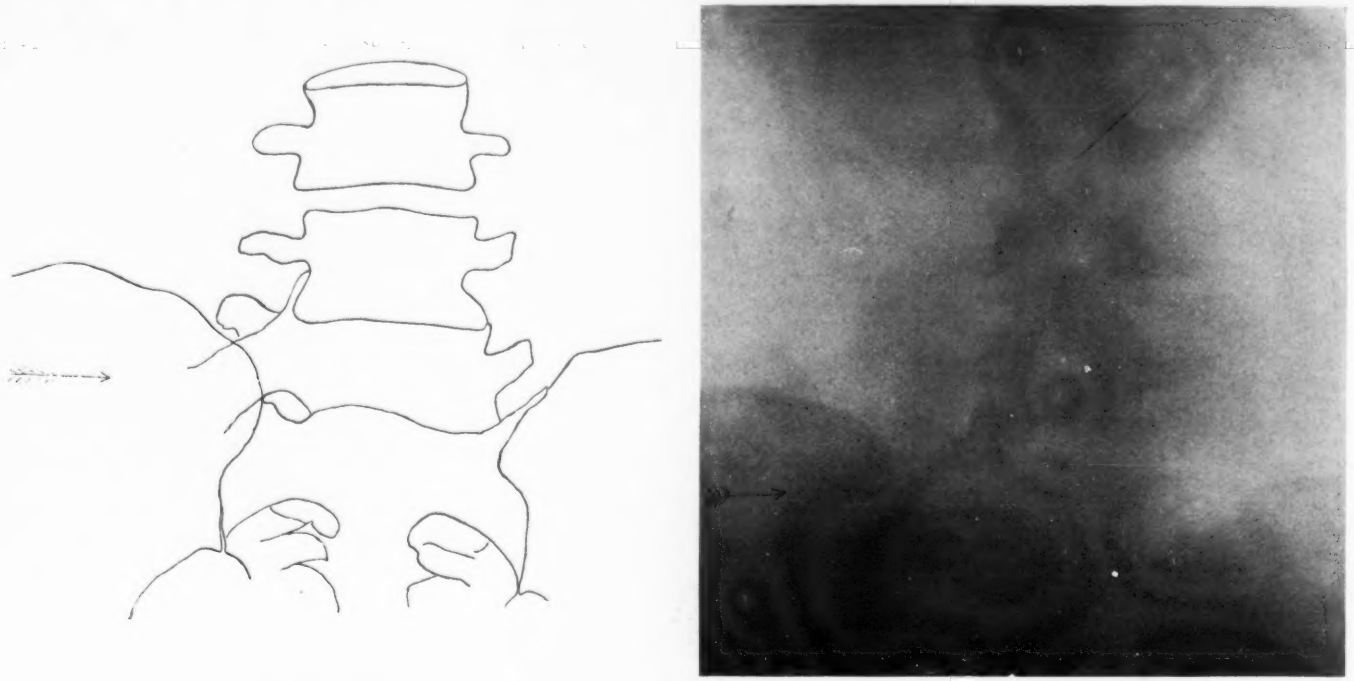
*Operation.*—The anomaly just described having been pointed out by means of the radiograph and its exact location and dimensions thus being made out, it was decided to operate in order to see whether it did not press directly on the lumbar sacral cord, thus causing the symptoms of sciatica. A vertical incision was made through the skin and fascia along the outer portion of the left lower erector spinæ group. These muscles were retracted inwards, but in order to get a better exposure a slight transverse incision was made into them. The quadratus lumborum was then separated from the erector spinæ group and we came directly down upon the transverse process and the rudimentary rib. One's finger was then inserted under the muscle and the rudimentary rib could be palpated, running down into the pelvis. It appeared to be about 1½ in. or 2 in. long. By probing with the finger within the pelvis the superior portion of the lumbar sacral plexus was found to be closely adherent to the rib along its anterior surface. This was gradually freed with the finger and the rib was excised. The wound was closed entirely, the muscles being sewn with catgut sutures, and the skin with subcutaneous silver wire. A plaster spica was applied. The patient was free from her severe pain almost immediately after the operation, but all of the tenderness did not disappear for three or four weeks. She was able to walk around on a crutch at the end of her third week, and could go about without any support in little more than a month. She is now able to do everything that a normal person can do, and is perfectly free from pain.

The next case, No. 3, is that of a man who had a large exostosis an inch and a half in length extending from the lower border of the third lumbar vertebra and impinging on the side of the fourth lumbar vertebra causing intense pain in the lumbar region.

Case III.—R. S., male; age 45; admitted to the hospital April, 1906; complains of pain in the lumbar region and radiating into the scrotum. Family history is negative. Previous history of usual children's diseases and gonorrhœa twenty years ago.

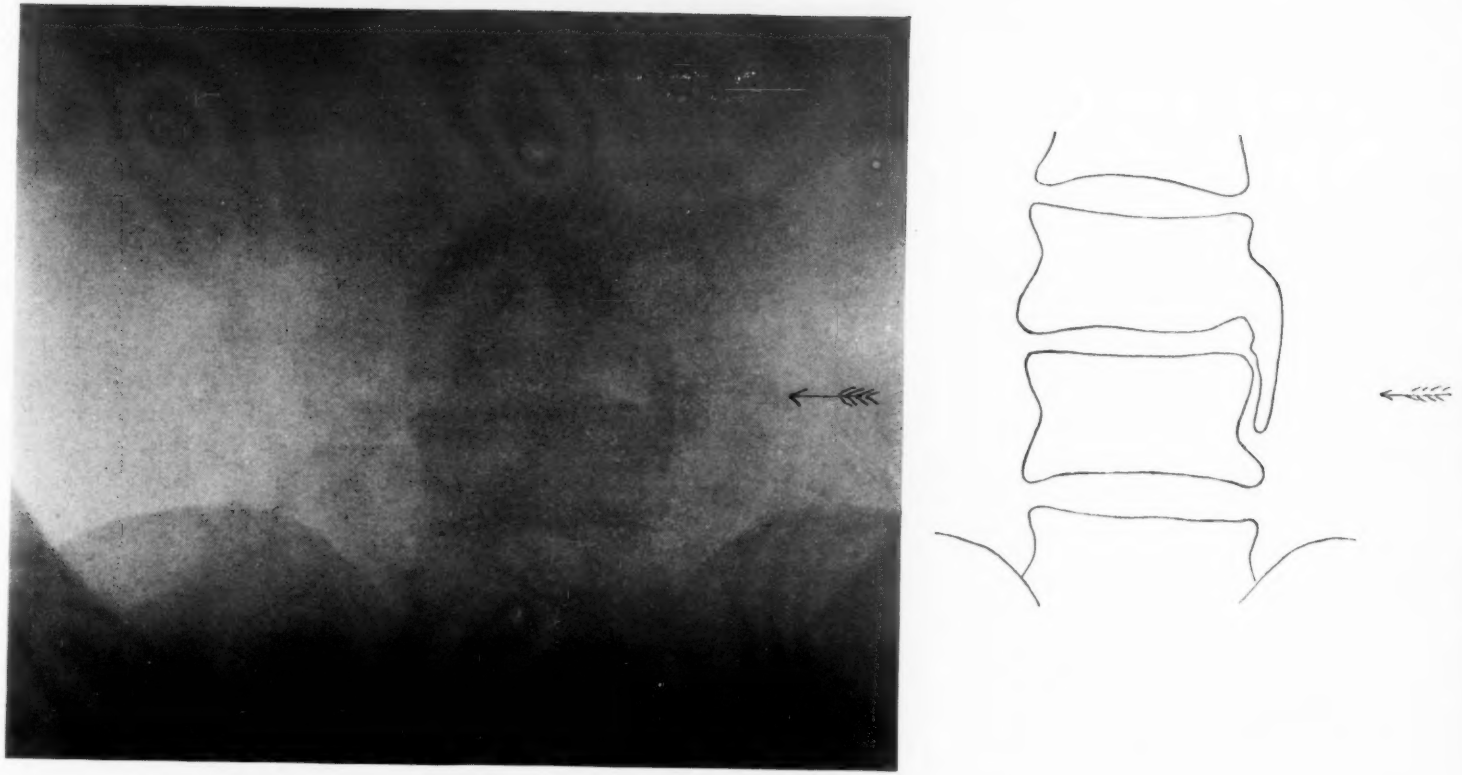
*Present Illness.*—For the past three years he has had marked pain in the right lumbar region; pain referred down along the right side and also into the scrotum. For the past five months the

FIG. 4.



CASE II.—Rudimentary rib, springing from the fifth lumbar vertebra and extending into the pelvis.

FIG. 5.



CASE III.—Exostosis from the third lumbar vertebra.

symptoms have been more acute, all motion in the lower spine seeming to intensify them, and at times the pain is so severe that he is weakened continually during the night.

*Physical Examination.*—At the local site of the disease pressure over the lumbar region causes intense pain. Motion of the spine especially in a lateral direction to the right or bending forward or backward is restricted as well as painful. Pain also radiates along the course of the sciatic nerve as far as the knee. The fingers of both hands show a mild grade of Heberden's nodosites. Examination of the ureters shows both to be perfectly patent, but some pus and casts were obtained from the right kidney.

The radiograph shows small calculus in the right kidney and a long finger-like projection of bone about 1½ inches in length, extending along the lower margin of the third lumbar vertebra and passing down along the side of the fourth vertebra. It can easily be seen when one looks at the radiograph how motions are restricted especially as the patient bends toward the right side.

The operation was performed upon the right kidney and a small stone removed. There has been an improvement of the urinary condition and the pain in the scrotum has disappeared. The pain in the back and along the sciatic nerve continued to be so bad that on December 12, 1906, the patient returned for an operation for the removal of the exostosis. This was done by a vertical incision along the outer edge of the right erector spinæ muscle and a small transverse incision into those muscles to afford better exposure. The exostosis shown in the radiograph Fig. 5 was about an inch and a half in length and bound down to the fourth lumbar vertebra by dense adhesions. This exostosis was removed close up to its base. The wound was closed by sewing the muscles together with catgut and the skin with subcutaneous silver wire. Three weeks after the operation the patient was perfectly well, and a letter from him yesterday said that he had had no pain since his operation.

From these three cases we are able to come to certain conclusions—in the first place, that the spine is the seat of numerous affections which differ materially in their etiology.

That these affections simulate the symptoms of other diseases to such an extent that mistakes in diagnosis are fre-

quently made and the patients subjected to therapeutic remedies which cannot be of help to them.

That in cases of persistent sciatica or pain along other nerves a radiograph of the spine should be made to determine whether there is not some point of bony pressure causing the trouble.

That operations on the spine for the removal of these troubles can be made in many cases with perfect ease and safety.

And that operation offers the quickest and most certain mode of treatment in a great majority of such afflictions.

# THE SURGERY OF THE THORACIC DUCT.

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THE thoracic duct has, from time to time, been the seat of injury, especially during operations on the neck, and in some instances, attempts have been made for its repair. Such cases are of great surgical rarity, and for this reason contributions to the surgery of the duct, are of professional interest. Rupture of the thoracic duct, as an accompaniment of the gunshot wound of the lung, has thus far been observed but once. It is no wonder that such injuries are rare, since the aorta lies in such close relationship to the duct that death usually occurs at once.

A recent case may be found in the book of Graff and Hildebrandt upon "Wounds Caused by Modern Firearms," [1] and is there described as follows:

The projectile passed from a point in the region of the apex of the heart, obliquely backward and to the right of the spinal column. Probably the wall of the duct was contused and necrosed, since the first symptoms of leakage developed only after a few days. The diagnosis was then made because of the chylothorax which developed. Several aspirations of the pleural cavity were necessary, and the patient finally recovered. Collateral branches evidently became functionally active, while the main duct which was injured, closed. The chyle ultimately reached the blood current through the newly dilated channel.[2]

A case in which the thoracic duct was injured during an operation upon the neck, was reported by the writer in his

[1] "Die Verwundungen durch die modernen Kriegsfeuerwaffen," by Drs. Graff and Hildebrandt, Berlin, 1907.

[2] Dietze, "Ueber Chylothorax traumaticus," Deutsche Zeitschrift für Chirurgie, vol. 73, p. 450.

recent article upon "A New Disease of the Thoracic Duct."[3] This was contributed by Dr. L. W. Pearson of Brooklyn, and may be summarized as follows:

Mrs. E. K., 45 years of age, suffered from enlarged cervical glands which had existed for about a year. They were most pronounced upon the right side of the neck and the mass extended nearly to the level of the clavicle. An operation was performed April 8, 1905, and the enlarged glands were removed. One gland which had suppurated and the fistulous tract leading to it, were also dissected away, the dissection extending to about an inch above the clavicle. Hemostasis was effected, and the wound was closed. The patient recovered from the anæsthetic and did well. On the fourth day she had one degree of temperature. On this day the dressings were removed. There was no suppuration, but the tissues near the suture line had melted away.

Two days later there was edema of the parts along the line of the incision and adjacent thereto. A probe was inserted at the lower point of the incision and a thick, curdy material began to pour out. As the wound was held wider open, about a pint of this material was evacuated. The wound was irrigated and cleaned, and then it was found that from the lower part of the wound, chyle welled up. This was removed as fast as it was sponged away, and for the next five days, large quantities of chyle escaped more or less continuously. The dressings were saturated and needed frequent changing. Notwithstanding this loss of the products of digestion, there was no especial sense of hunger expressed by the patient, through she was growing somewhat weaker. The temperature varied from 100° to 100.5° and the tissues melted away. At no time was pus present.

On the eleventh day when the dressings were removed for inspection, the flow of chyle seemed to have diminished. The wound was tightly packed with iodoform gauze with hope of its closing. On the next day, the flow of chyle was very slight, on the following day no chyle appeared. The wound itself rapidly closed in from this time forward, and convalescence was uneventful.

By far the most valuable contribution to this subject, however, is the one recently found in the "Festschrift" in honor of the seventieth birthday of Prof. Ernst von Bergmann, and was prepared by Dr. Fritz Lotsch.[4] It is as follows:

"A wound of the ductus thoracicus at a point near its outlet is an always rare complication of operations upon the left side of the neck."

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[3] New York State Journal of Medicine, July, 1907.

[4] Ein Beitrag zur Chirurgie des Ductus thoracicus, by Fritz Lotsch, Surgeon 30th Regiment, Madgeburg Fusiliers, Berlin, 1906.

The first observation recorded upon this subject, was made by von Boegehold in the year 1883. He writes:

"Strangely enough, with the exception of the case observed by me I have never seen a reference to wounds of the thoracic duct in the neck, although with the extirpation of large tumors in this region, such an accident can easily happen."

Since that time current literature upon this subject has slowly increased from year to year. Unterberger [5] collected at the end of the year 1905, all of the cases in the Königsberg Surgical Clinic, of operative wounds of the thoracic duct which had occurred and found them to be thirty in number.

Certainly not all cases have been recorded; for instance, in the atlas of Bockenheimer and Frohse it is stated "In spite of all care it will some time occur in the sawing through of the clavicle that the thoracic duct is wounded. It is not necessary to suture it, since a tamponade will, as a rule, remedy the injury."

It is certain, however, that the wound of the duct, considering the vast amount of material reported, is not an every-day occurrence. The case reported by Dr. Lotsch is as follows:

Mrs. Clara H., aged 30 years; recurrent sarcoma of thyroid gland. Partial resection of gland at primary operation April, 1904. Secondary operation April, 1905.

Transverse incision of the old scar. Extirpation of the individual tumor masses. The left internal jugular vein was ligated.

During the dissection of the nodules in the left supra-clavicular fossa, the deeper portion of the wound suddenly filled with turbid milky fluid, which welled up instantly as soon as it was sponged away. The duct, the size of a straw, was exposed and a cut involving one-third of its circumference was visible. The incision was closed with three fine catgut sutures. The chylorrhea ceased. During further dissection the bulb of the left common jugular vein was exposed and was accidentally torn open. The severe hemorrhage which occurred through this slit-like wound was controlled by a suture of the wall of the vessel. The tumor was finally removed upon both sides, each mass the size of a pigeon's egg. Both surgical triangles of the neck, from the angle of the jaw to the aperture

[5] Unterberger, Ueber operativ Verletzungen des Ductus thoracicus, Beiträge zur klinische Chirurgie, Bd. xlvii, Hft. 3.

of the thorax, were dissected as free as in an anatomical preparation. Gauze drainage. Suture of the wound.

April 13. Temperature continues normal. A marked edema of the left side of the face had developed. Otherwise the patient was in excellent condition. The wound healed per primam. In the drainage opening fresh granulation tissues appeared. The wound being nearly healed, she was permitted to go home.

March, 1907, one year after the second operation, the patient was found to be entirely free from recurrent growth and in excellent health. (This ends the case history.)

This case had to do, therefore, with an oblique wound of the thoracic duct in the supra-clavicular fossa occurring during the extirpation of a firmly adherent secondary nodule of sarcoma.

The severe chylorrhea was controlled by catgut sutures of the wounded duct.

At the present time the therapy of wounds of the thoracic duct has not a firm basis chiefly because of anatomical variations and partly also for physiological reasons. At least from a practical surgical point of view the rules thus far laid down are uncertain.

Even to-day, the conclusions reached by Tholes (1901) are still accepted. "Our knowledge of the exact anatomical relations is still defective and needs the added experience of numerous investigations, such as are given in the works of Boegehold and Wendel. Perhaps it will develop that many conditions now regarded as variations, will prove the normal condition and are the natural safeguards of the body against an occasional wound of such an important structure."

The real question to be considered, therefore, is, Is it possible to ligate with safety the wounded trunk of the thoracic duct in man?

The thoracic duct conveys, as is well known, the finished products of digestion, the chyle, into the blood current and in addition collects the lymph of the entire body, with the exception of the right upper half of the body, whose lymph channels ultimately fuse in the ductus lymphaticus dexter. The current of the chyle is controlled by the movements of respiration. With each inspiration there occurs a temporary negative pressure within the thorax, which sucks the chyle from the

abdominal cavity. Some observers have occasionally discovered that the chyle has a rhythmic motion synchronous with each inspiration very similar to the pulse. (Keen, Cushing, Schroeder-Plummer, Lecène.)

Concerning the course and topography of the extra-thoracic portion of the thoracic duct, the following is a short résumé.

The ductus thoracicus passes on the left side of the œsophagus in the cephalic aperture of the thorax. At the level of the sixth vertebra it turns sometimes in an acute, sometimes in an oblique curve, upward and forward, and terminates in the angle of junction of the left sub-clavian vein with the jugular vein where both of these vessels unite to form the vena anonyma sinistra. Shortly before its termination it receives the lymph duct, coming from the left side of the head and neck (truncus jugularis sinistra), as well as that of the left arm (truncus sub-clavius sinistra), finally also the truncus lymphaticus mammarius sinistra.

At the mouth of the duct in the wall of the vein there are two valves which prevent the flow of blood back into the lymph channel.

It is well recognized how variable and inconstant the course of even the large lymph vessel is, and attention has often been called to the frequent inconstancy in position of veins, arteries and lymph vessels. These variations occur also in the ultimate termination of the great lymph channels, the thoracic duct.

In the present instance we are concerned chiefly with the anomalies in the region of the mouth of the duct. It is important for surgeons to know that the thoracic duct occasionally terminates upon the right side, and that upon the left side in such cases the duct conveys only the lymph from the left upper quadrant of the body into the blood current. Whether these anomalies habitually occur with situs viscerum inversus has not yet been determined. Very often anomalies of the blood vessels are present in the same individual.

Of primary importance for the surgeon in treatment of

the wounds of the duct, is the position which the terminal opening occupies in the vein, whether it is in the re-entrant angle or in the jugular or in the sub-clavian vein alone. All possible combinations may occur which can be theoretically imagined. The jugular, sub-clavian and the mammarius veins sometimes have the duct lying close along the wall of the vein; sometimes the ducts of which there may be several are separate and enter the blood current in two or three places. Several anastomoses can sometimes be determined. Not infrequently the duct, after it is joined by the already mentioned lymph channels, divides into a larger or smaller number of fine vessels, sometimes short and sometimes long, which separate or anastomose in several places before they finally enter the wall of the vein. This delta formation is probably the reason why so many variations have been observed. As a rule it is probable when the main channel fills that most of the chyle will pass through it and the smaller ones become so attenuated from inactivity that they escape observation.

In a similar manner may be explained those anomalous lymph channels which have been observed and described in connection with the lymphatic glands of the breast, as they course along the wall of the thorax or of the abdomen. Wutzer, Wendel and Arnold have described communications with the vena azygos; Wendel has observed one with the vena renalis.

When one considers what an important rôle the thoracic duct plays in the function of the entire body, it is little wonder that numerous collateral branches exist to provide against emergencies.

A great many investigators have sought through experiments upon animals to answer the question as to the result in case the thoracic duct was completely occluded. Most of these investigations have been conducted upon dogs. The result in the greater number of cases was merely a temporary impairment of nutrition.

On the other hand, if the duct is cut through without ligating it, there occurs at once the symptoms of a profuse

chylorrhea, which if it be not checked either by accident or by design, will in a short time lead to progressive loss of strength and finally to death.

In the wounds of the duct which have occurred during operations this chylorrhea, strangely enough, often does not develop for some hours and often even days after the lesion has taken place. (Thöle, Schopf, Phelps, Vagedes, Ricard, Wendel, and Halsted.) Probably in these cases there was a narrow slit in the wall of the duct which was temporarily closed, by a small clot of blood or something of that sort.

The tremendous amount of chyle which can escape through the duct which has been opened by accident has been shown in some operative cases, in which efforts to check the chylorrhea did not succeed. (Schwinn, Schroeder-Plummer, Schopf, Ricard and Thöle, whose patient was literally deluged in chyle.)

Especially characteristic in this connection is the case reported by Hahns, in which as a result of an intra-thoracic rupture of the duct nearly 30 litres of chyle were withdrawn by aspiration.

The disease picture which develops as a result of chylorrhea has been observed and described several times (Wendel, Schwinn, Schroeder-Plummer, Schopf, Ricard, Thöle). The digestive organs work in vain. Hunger and appalling thirst develop. Ingestion of food is followed by a marked increase in the chyle which forms and escapes. Emaciation and progressive loss of strength, weakness of the heart action and finally loss of consciousness follow as a result of such a condition. Whether the fever which has been occasionally observed is due to absorption of nucleins and albumins is not certain.

Death, notwithstanding all this, is rather uncommon. The chyle possesses a certain ability to coagulate, yet as a rule, sooner or later the stream of chyle reaches the general circulation through other newly dilated channels.

In many cases after tamponade of the wounded duct, the patient complains of a pressure in the thorax. When the bandage is loosened in such cases, profuse chylorrhea is observed.

More frequently in the first few days after the accident, circumscribed edema occurs in the certain areas. Unterberger describes edema of the left arm; in our own case an edema of the left side of the face was observed which was increased after the ligation of the jugular vein. All these observations seem to indicate that a certain time is needed to establish collateral circulation and to give these non-functionating vessels a chance to dilate. It has never happened, however, that the pressure in the duct in any case is so greatly increased that a rupture of the duct or of one of its radicles has occurred.

The disturbances of circulation which have occurred after operative wounds of the duct have taken place, are as a rule not excessive,—since the pressure of the tumor masses or of the large abscess cavities has already caused a certain development of the collateral branches before the operation takes place.

In the 31 cases observed, 15 were operated on because of malignant tumors (usually metastatic), and 13 because of tubercular adenites. In two (Cheever and Schroeder-Plummer) the character of the tumor is not stated, and in one case (Ferguson) an aneurism of the left sub-clavian artery existed.

In all of these cases there existed conditions which might give rise to marked pressure upon the duct, and therefore it is not possible to exclude the possibility of a more or less collateral circulation. Some observers have described the escape of the chyle in a rather thick stream (Boegehold and Lotsch) of the size of a straw; Schwinn speaks of the size of a knitting needle. Lecène gives a lumen of from 1 to 3 mm.

Two cases of death have occurred in the 31 cases reported in which the thoracic duct has been wounded during the operation (Cheever, Schopf). Lotsch does not agree with most of the writers that one is therefore justified in regarding this as the cause of death. The patient of Cheever died thirty-six hours after a very severe operation as the result of shock. The chylorrhea was checked by a firm tamponade.

The patient of Schopf dies 16 days after the operation. Autopsy showed an excessive chylothorax on both sides, with a

fibrous pleurisy and pericarditis on the left side, so that death cannot properly be ascribed to the wound of the duct alone.

It therefore follows that the prognosis in wounds of the duct is by no means so bad as it appears to be at first sight. Efforts made to check the chylorrhea in some way or another have nearly always succeeded. In the more unfavorable cases a pronounced loss of strength developed, from which the patient recovered after a long convalescence.

In view of our present knowledge of this subject, are we justified in treating the wound of the duct precisely as we treat those of blood vessels. Several methods are to be considered in this connection.

1. Ligature. 2. Suture. 3. Suture of the enclosing tissues. 4. Application of an artery clamp. 5. Compression by firm tamponade.

The implantation in the vein of a duct which has been cut across (Schopf) is scarcely possible on technical grounds, and has completely failed in satisfactory results.

Of the various methods which have been attempted, the one should be given the preference which with certainty will check the chylorrhea at once. All plans are not of equal value. Ligation or suture upon the one side and tamponade upon the other may be compared with each other. Formerly most operators preferred tamponade, but in more recent years nearly all authorities have recommended ligature. In most cases tamponade has failed to check the chylorrhea immediately. Ligature and suture when properly applied at the place of the injury must of necessity check the flow of chyle. They are therefore the methods to be preferred.

One drawback, however, exists—a technical one. It is often impossible, at the bottom of a funnel-shaped wound, to see the exact site of the injury and to grasp the duct. The nearness of the pleural cavity and of the large blood vessels of the neck, adds a considerable risk, and it is with great difficulty that the duct can be grasped for the proper application of a suitable clamp. In such cases of necessity the tamponade may be used when other methods cannot be applied without great

additional danger. Actual suture at the site of the injury on the wall of the duct, occupies a peculiar place. In many cases occurring during the operation, the surgeon has to deal not with the total division of the duct, but rather with a slit-like opening caused by the firmly attached portions of tumor breaking the wall of the duct during their removal. If it be possible to bring this slit clearly in view, then a suture is technically possible, and the result must be a most satisfactory one.

The wound does not close spontaneously, since the chyle has little tendency to form a clot, and the pressure from within is great enough to keep the wound open. It therefore follows that a suture can be used only in a limited number of cases, and in any case, is not technically easy. It is however to be attempted in this special class of cases, since it is the only means of controlling the leakage from the duct.

In the 30 reported cases, ligature was used 9 times, 6 times with an immediate result. In 2 cases the result was attained only after a certain time (Weischer 8 days, Unterberger 18 days, Schroeder-Plummer (2), Lesniowski (2), Brohl, Thöle, Receni and v. Graff). The case of Ferguson is not included, since the attempts at suture failed. Schroeder-Plummer had to report a complete lack of success in his first case. The ligature was applied when the clamp was removed and immediately the chylorrhea recommenced, a certain indication that the ligature was not properly applied. Tamponade for three months led to a progressive cessation of the chylorrhea. This mischance was not due to the fault in the method, but rather to the imperfect technique.

Suture of the tissue (Umstechung) was used in two cases of Wendel and von Schopf, and both cases were successes. In Wendel's case neither tamponade nor clamps nor repeated tissue suture succeeded in checking the chylorrhea. Suture gave only temporary benefit. Finally the use of a firm tamponade held in place for five weeks. Clamps applied for a considerable time were used in this case.

Phelps and Schwimm could not ligate the duct because of the depth of the wound. A clamp was applied and left in

place for three days; this succeeded in terminating the chylorrhea. In Wendel's case two clamps were applied. Chylorrhea ceased on the fourth day. In three cases the method failed and tamponade was then applied.

In 13 cases a tamponade was used; in 6 the flow was controlled at once. In Ricard's case the wound was dressed upon the sixth day and then for the first time a collection of milky fluid was observed. This is very similar to the case of Pearson. This was first thought to be pus, and only after 14 days was a tamponade applied. In the remaining cases chylorrhea ceased after a variable time (from five days to five weeks). Both cases which died (Cheever and Schopf v. s.) were treated by means of tamponade.

## CONCLUSIONS.

1. The thoracic duct probably has collateral branches always which are able, in case of accident, to perform the function of the main duct. Further anatomical investigations concerning this are greatly to be desired.

2. The sudden closure of the duct in man has had as its result only transitory disturbance in the nutrition of the body.

3. Chylorrhea occurring after a wound of the duct, must, if possible, be immediately controlled.

4. The wounded thoracic duct may be treated precisely as we would treat a wounded blood vessel.

5. Suture is the ideal method. If it is technically possible, its use is to be preferred, since the duct then remains patent.

6. In all cases in which suture can be performed, a ligature should be applied. If ligature is technically impossible then in order of value, suture of the tissue (Umstechung), application of clamps, and in emergency, as a last resort, tamponading should be applied.

NOTE: *Bibliography.*—A complete bibliography of the subject will be found appended to the memoirs of *v. Graff,* Zur Therapie der operativen Verletzungen des Ductus thoracicus, *Weiner klin., Wochenschr.* 1905, Nr. 1, and *Unterberger,* Ueber operative Verletzungen des Ductus thoracicus, Beiträge zur klin. Chirurgie. Bd. 47, Heft 3.

# DERMOID CYST OF THE HEAD.

EXCISION, USING CRILE'S TEMPORARY CLAMP ON THE COMMON CAROTID.

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THE situation of dermoid tumors usually follows certain definite lines, as Mr. Bland-Sutton has pointed out. The vast majority of these growths are found either in the abdomen, especially in connection with the ovary, or else about the embryonic fissures. Those fissures which, when closing, separate a mucous from a cutaneous surface, are especially prone to be the seat of dermoids. Thus, it is not uncommon to find them about the coccyx, where the posterior fissure closes, and about the eyes, springing from the orbito-nasal fissure. The lower part of the nose, the middle of the upper lip, and the outer angles of the mouth are regions where dermoids of the face arise because of the previous existence of fissures at these points. The floor of the mouth, resulting from the closure of the intermandibular fissure, is not an infrequent region for these cysts, and here they are often confused with retention cysts. The resemblance of these two classes of cysts is all the more confusing when the dermoid is derived from the implantation of an early matrix before the more complex epithelial elements have formed. In such instances, the contents may be of a mucous character, resulting from the degeneration of the lining epithelium of the dermoid, and consequently be almost identical with the contents of retention cysts found in this neighborhood. If, however, the matrix from which the dermoid arises is of a later stage of development when such structures as hair or teeth may arise from it, the differential diagnosis is clear. Dermoids in the neck are usually derived from inclusion of a matrix from the branchial clefts.

It has been generally believed that the ovary is the most

FIG. 1

Dermoid cyst of head. Photograph taken a few days before operation.

frequent site of dermoid cysts. This is due to the fact that such tumors of the ovary often attain large size and, consequently, are reported more frequently than the smaller and more insignificant dermoids in other regions of the body. Then, too, the dermoid of the ovary often contains other elements than those of epithelial origin, which makes the tumor of a more sensational character and, therefore, more likely to be reported. For instance, cartilage and bone showing a mixed matrix are often found, whereas dermoids of the subcutaneous areas are almost always of a pure epithelial origin.

The following case is reported because the dermoid was in an unusual location, apparently springing from the temporal fossa, and because it is an exceptionally large one for this region. Senn says that with the exception of the ovary, "dermoid tumors larger than a hen's egg are rare." From an operative standpoint some interest may attach to the effect of temporarily clamping the common carotid—a method recommended by Crile. The absence of injury to the artery is shown quite clearly in the specimen which consists of the common carotid and the first portions of the internal and external carotids.

The patient was a negro man, forty years of age, of a rather low degree of intelligence. His previous history was vague, but from what could be gathered he seemed to be in good health until two years before admission to the hospital, though he had never been very robust. About two years before the present operation the left side of his lower jaw was fractured as the result of an accident. This was followed by some tumor formation, as well as I can gather from his history, and as a result the left portion of his lower jaw was excised by another surgeon. Soon after this operation he noticed a growth beginning on the left side of his face, apparently involving the upper jaw. Later the tumor grew more rapidly, and became quite painful, the pain being due, apparently, to pressure upon branches of the fifth nerve. His appearance on admission to the hospital, January 2, 1907, is well represented by the accompanying photograph (Fig. 1). There was no paralysis of the seventh nerve, and no paralysis of sensation. Certain portions of the tumor presented a bony consistency

and over other portions distinct fluctuation could be obtained. The hard area of the tumor corresponded to about the region of the malar bone, and was later shown to be due to the fact that this bone and the adjacent portions of other bones were attached to the wall of the cyst and had been pushed forward and outward by the growth of the tumor. The part that showed fluctuation was where the cyst wall was covered merely by skin and subcutaneous soft tissue. The patient was considerably reduced in strength and weight, and suffered neuralgic pains from pressure almost constantly. On admission his pulse was 80, temperature 98.4, respirations 18, urine normal. He had considerable difficulty in chewing owing to the previous removal of part of his lower jaw, and also because of the tumor. He was given tonics and soft diet and every effort was made to build him up. The nose and throat were sprayed with an antiseptic solution several times a day and the mouth cleaned after feedings.

On January 8, 1907, I operated upon him at the clinic under ether narcosis. A hypodermic of morphine and atropine was given before the anæsthetic was started. An incision over the anterior lower portion of the sternomastoid muscle exposed the common carotid, which was clamped with Crile's clamp, both blades of which had been covered with rubber tubing. The skin over the most prominent area of the growth appeared moderately adherent, so the incisions were fashioned in such a manner as to leave this part of the skin attached to the tumor, as it was thought at the time that the tumor was a sarcoma. A long incision, starting behind and above the outer angle of the orbit, swept down somewhat posterior to the most prominent portion of the tumor, and curved forward underneath the jaw. Another incision, connecting the horizontal and vertical portions of the first cut, left an island of skin over the most prominent part. The upper part of the tumor was then exposed, and the outer wall of the orbit cut through with bone forceps. The lower wall of the orbit, the superior maxilla near the alveolar process, and the zygoma near the temporal bone were similarly cut and the lower and outer portion of the wall of the orbit, including all of the malar and part of the superior maxilla, was removed with the growth. By dissecting from above downward and keeping as far from the capsule of the tumor as possible it was excised intact. Particular care was taken to avoid rupturing the cyst. As the

FIG. 2.

The interior of the common and internal carotid arteries. The Crile clamp had been applied about point "A." Note entire absence of injury to the intima. The few shreds of fibrin, found in all large arteries after death, have not been removed.

FIG. 3.

Lateral view, showing the external carotid, which has been split to the ligature, still containing part of a clot.

patient had been placed with his body and head in a semi-sitting position but little blood was lost from oozing, and the temporary clamp on the common carotid controlled arterial bleeding perfectly. Not more than an ounce and a half of blood was lost at the operation. When the growth was removed the external carotid was ligated near its origin, as on account of the bony surfaces left it would not have been practicable to control the terminal vessels from this artery by ligatures. The clamp was removed from the common carotid and the wound sutured. The patient suffered somewhat from shock, but an hour after returning from the operating room his temperature was 98.3, pulse 100. His condition the following day was satisfactory, except that deglutition was rendered painful and more difficult by reason of the extensive operation. Anticipating the possibility of pneumonia, a pneumonia jacket was applied and the nose and mouth frequently sprayed with antiseptic solutions. During the first forty-eight hours after operation he vomited a few times. On January 10th, his temperature reached 101, the highest point up to that time since the operation. His pulse was 120 and respirations 32. Examination showed beginning pneumonia, and the patient was referred to Dr. M. Call, Professor of Medicine in the Medical College of Virginia. The respirations and pulse increased in rapidity until a few hours before his death, when the pulse was 162 and respirations 52, with a temperature of 102. He died about nine P.M. on January 14th.

The post-mortem held by Dr. Call a few hours after death showed consolidation of practically all of the lower lobe of his right lung and portions of the upper and middle lobes. There were old pleuritic adhesions on the right side. Death was due to pneumonia. The wound was in excellent condition, and had healed by first intention throughout most of its extent. There was no suppuration at any point. Most of the trunk of the common carotid with portions of the internal and external carotid arteries was removed in one specimen. The common carotid showed no injury at the point where the clamp had been applied (Fig. 2). The lumen of the internal carotid was free, as was also that of the external carotid up to the ligature. On the distal side of the ligature a clot filled the lumen of the external carotid for about half an inch. The condition of the arteries is shown in the accompanying photographs (Figs. 3 and 4).

I am greatly indebted to Dr. Joseph Bloodgood, of Baltimore, for the following report:

"March 10, 1907.

"*Pathology:* P. No. 8007, *Gross.*—The specimen consists of a cystic tumor of the peculiar shape shown in the photographs (Figs. 5 and 6). It measures about 6 inches in length by 3 inches by 4 inches. Over one side there is an elliptical piece of skin 4 inches by 1¾ inches. On another side is a flat piece of bone 2½ inches by 2½ inches in surface diameters. The bone, however, is exposed in only one area, which suggests the inferior orbital ridge of the superior maxillary bone. The remainder of the bone is covered with muscle, subcutaneous tissue and fat, as if it represented the anterior wall of the antrum. Attached to the cyst wall are pieces of fat, muscle and connective tissue. The cyst wall can be stripped from the piece of bone and leaves it denuded of its periosteum. On opening the cyst, it contained a thick, brown fluid, quite granular and of the appearance of contents of a dermoid into which there has been some hemorrhage. When this contents is washed out, in one or two places the granular masses of the contents stick to the smooth cyst wall within. The wall in some places is gray in color, in others stained brown with blood. It looks like epithelium-lined tissue. On section it is composed of a dense membrane not more than 1 mm. in thickness. Beyond this membrane in some places there is no other tissue, it is adherent to the bone over the piece described, while in the remainder there is muscle beyond.

"Path. No. 8007. Microscopic study:

"Section 2. Thin cyst wall. Section shows fibrous connective tissue in lamellæ. On the cyst side the connective tissue is much more compact and on the surface in the first layer of connective tissue there are numerous spindle nuclei suggesting the basement membrane beneath an epithelial lined surface but no epithelium is to be seen. Beneath this there is some pigment. In the wall further from the surface there are numerous round and spindle nuclei in the fibrous connective tissue and here and there small areas of lymphoid cells. Deeper there is the remains of a striated muscle undergoing pressure atrophy. There are very few blood vessels and no giant cells. We have the usual picture of connective tissue wall of the cyst, but the epithelial lining quite often found in the dermoid is not present. Here and there are large vessels filled with blood cut both longitudinally and across. As the cellular areas are most marked where we find remains of muscle they suggest the indication of an interstitial myostitis from pressure. The round, spindle and lymphoid cells are found also in the region of vessels.

"Section 1. The thicker portion of the wall including muscle. We have the same picture seen in section 2, but no epithelial lining. Beyond this muscle it is almost completely replaced by fibrous tissue, with here and there a blood vessel surrounded by lymphoid cells."

FIG. 4.

Lateral view, showing ligature on the external carotid.

FIG. 5.

Anterior surface of the tumor. Note near the bony end a portion of the island of skin left attached to the tumor; near the upper end part of the bony wall of the orbit.

FIG. 6.

Internal surface of the tumor.

# STYLO-HYOID OSSIFICATION.

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*"Observavi tamen aliquando processum styloideum usque ad cornua ossis hyoidei pervenire, ipsisque valido nexû devinci."* *de Marchettis.* Anatomia. Patavii, 1652, cap. xiii, p. 205. Probably the earliest reference to this condition.

Although the occasional recurrence of ossification of the second branchial bar, represented by the styloid process, the stylo-hyoid ligament and the lesser horn of the hyoid, has been repeatedly observed in man, yet the number of well described cases is very small. Le Double in his work on the variations of the facial bones finds only some twenty instances of which one or two have never been published and of which others are very inaccessible. This condition has most frequently been recognized in the living by laryngologists, but it may be said that its clinical importance has not been generally appreciated. It appears, moreover, that there is even among anatomists more or less misunderstanding as to what has actually occurred in these cases, and that the nomenclature of the parts involved is very confusing.

This subject has been particularly brought to my attention by the observation of a very perfect case of ossification of practically the whole chain on both sides in a dissecting room subject. Moreover, the peculiarity was discovered before the dissection was very far advanced so that it was possible to have the body X-rayed before the relations which existed in life had been very seriously changed. At almost the same time two extremely long styloid processes, reaching nearly to the hyoid, were observed on another subject which was also X-rayed. So far as I am aware these skiagraphs are the first that have been made of this condition.

In this paper I propose (I) to describe the composition

of the stylo-hyoid chain and to show what occurs in ossification of the chain or of parts of it; (II) to describe cases of extensive ossification of my own observation, and others in the Warren Museum of the Harvard Medical School, and then to mention the peculiarities of a number of other specimens found in literature; and (III) to refer to the clinical importance of this condition.

## I.

*The Stylo-hyoid Chain.*—The second branchial bar or the cartilage of Reichert, extends in early embryonic life downwards and forwards from the skull to meet its fellow to which it is connected by a cross piece the *basi-hyal* which becomes the body of the hyoid. The chain of pieces with which we have to deal does not include the basi-hyal. It consists of four elements. (1) The *tympano-hyal* extending from beside the periotic capsule, which later is enclosed in the petrous portion of the temporal bone, to the lower surface of that bone or a little beyond it. The late Professor Flower was, we believe, the first to suggest the name we have used for this element. French writers call it *le prolongement hyoïdien.* (2) The *stylo-hyal,* which usually forms the greater part of the styloid process: (3) The *cerato-hyal* which is usually represented in the adult by the stylo-hyoid ligament, or by an ossification in the same, and (4) The *hypo-hyal* which becomes the lesser horn of the hyoid. There is unfortunately more or less confusion in the nomenclature. Some writers call the cerato-hyal the lesser horn and some use the term *epi-hyal,* which we have avoided altogether, for diverse elements. Some parts of this cartilaginous chain become bone by the normal process of ossification, but other parts degenerate into fibrous tissue. Before considering the remarkable cases of extraordinary ossification, something should be said of the usual course of events and of minor modifications.

Let us examine very briefly these different parts of the stylo-hyoid chain in a little more detail. First: what constitutes the normal styloid process? There is a very confusing

discrepancy of opinions. The soundest view is that according to which it consists of the tympano-hyal and the stylo-hyal. Normally the tympano-hyal projects but very slightly beyond the temporal and shows a rough circular end which is connected with the next piece by cartilage or perhaps by fibrous tissue during adolescence and sometimes for a much longer period. Ultimately it fuses with the styloid which is thus joined to the skull. Yet I have seen a skull said in the catalogue to be of a child of eight, but which I should call some four years older, with the tympano-hyal projecting a centimetre or more from the base and joined to a second piece by a jagged line of union. In several of the anomalies to be described later the tympano-hyal projects considerably.

Sappey, following in the main Geoffroy-Saint-Hilaire, who was the first of modern authors to write on the hyoid chain, makes the styloid process consist of the first and second pieces, but he adds that the cerato-hyal ossifies before the stylo-hyal. In his diagram of what is normal he figures a free ossification in the cerato-hyal. He believes that this fuses with the tympano-hyal and the other where it fuses with the cerato-hyal. The theory that the fusion of the cerato-hyal with the stylo-hyal forms the tip of the styloid is very hard to determine; but it is a plausible explanation of instances when the point of the styloid, especially of a long styloid, joins the shaft at an angle.

Sappey seems to be alone in supposing that the cerato-hyal ossifies before the stylo-hyal. For our part we believe that it is quite exceptional for the cerato-hyal to ossify at all, although sometimes it presents a long slender ossification. It is possible enough that the upper end of this may join the styloid but we do not believe that this is the usual process. The lower end of this ossification may join the hypo-hyal thus making a very long lesser horn. Finally the normal ligament may be absent altogether, the original cartilage having disappeared and left no trace.

The hypo-hyal or lesser horn normally persists as an elongated cartilaginous nodule which is connected to the hyoid

by a ligament or by a true joint, and which late in life may be joined to it by bone. Sometimes, indeed, this bony union occurs very soon. The usually small nodule may be long and even double. It may fuse with the cerato-hyal. On the other hand it may be represented by fibres forming the lower part of the stylo-hyoid ligament, in which case the lesser horn is said to be wanting; and finally as in the cases just referred to, there may be not even a ligament. Thus it appears that the process of development presents a great number of individual variations and moreover that the same, or at least a similar, result may be reached by different processes. Thus the styloid need not always be composed of the same pieces, and the lesser horns may be elongated either by uncommonly large hypo-hyals or by their fusion with an ossification in the cerato-hyal.

A most important point in the consideration of cases of almost total ossification of the chain is that this is not to be considered a degenerative change, depending on age. That this idea was formerly held can be shown by quotations from eminent anatomists. Thus Gruber wrote: "Should the stylo-hyoid ligament become ossified throughout its length and also in rare cases among old people become joined with the styloid process, then the last will reach from the skull to the hyoid as was first observed by de Marchettis and after him by others and myself." Sappey alludes to the ossified cerato-hyals joining the styloids at from fifty to sixty and adds that the styloid process then takes on what he calls a "monumental" appearance twisted and knobbed, which characterizes it in some individuals. Though we believe the joining at that age to be entirely imaginary we quote the passage as showing the existence of the idea that these things come with advancing years.

Debierre, I believe, was the first to protest against this view. He writes, "Mais il ne faut point dire, avec nombre d'anatomistes, que dans certains cas le ligament stylo-hyoidïen s'ossifie. Ce n' est pas ainsi que se rétablit la chaine hyodïene osseuse." Peter who studied a large series of hyoids says

of the instances of remarkably long lesser horns that five of the most striking cases occurred in persons of from fourteen to twenty-five years. Le Double insists that it is to be considered a theromorphic manifestation.

The facts are these. It is perfectly true that in certain cases cartilaginous and fibrous tissues degenerate by the deposit of earthy salts into what may be called bone. Although most likely to occur in old age, yet it not rarely occurs early and is apparently to be attributed to constitutional causes.

In point of fact these cases are due chiefly (if not in all details) to the persistence of the embryological cartilage, to its growth to an abnormal size and to its final conversion into bone. This last is not a degeneration of tissue but the normal process as it occurs among animals in general. This is made very striking in most of these cases by the large size of parts of the hyoid chain which could not be explained by the degeneration of ligament. It is very probable also that in some cases in which the bony rod is slender the cartilage has persisted and become bone, because this is more likely than that fibrous tissue should have ossified at that age; but in the former cases the bar of bone is so large that one can only account for it by supposing that the original cartilage continued to grow and then underwent ossification. In these cases the rod is not one continuous piece but is made of several segments which generally present enlargements at their points of junction. The joints between these pieces have not received very satisfactory description. The fact is that they apparently are not true joints at all, but that the still cartilaginous ends of the pieces play one on another within the enveloping fibrous tissue which is continuous with the periosteum. The apposed ends of the bones have the appearance of having been connected by cartilage, and ultimately they become anchylosed to a greater or less extent, which indeed is an ultimate degeneration. Other instances of senile degeneration which has attacked the already abnormal structure will be alluded to in the account of the cases.

## II.

*Description of Cases.*—I shall now describe three recent specimens of my own observation, then two more also in the Warren Museum of the Harvard Medical School which have never been described at length, after which I shall give a short account of several cases recorded in literature, and then give a short summary of the results of the study.

### SPECIMENS IN THE WARREN MUSEUM.

CASE 1 (Figs. 1 and 2).—White, male, old. The chain of bones consists on each side of three pieces besides the lesser horn, which on the right is very small and ill defined, lying in the mass of fibrous tissue which passes from the piece above it to the hyoid. On the left it is represented by two nodules, one above the other. The first piece on both sides measures 2 cm. and is enlarged at the lower end, which is movably attached to the second piece, which measures 4 cm. on both sides. Its lower end is also slightly enlarged. It is movably attached on the right; but on the left is fused with the third piece, which is directed strongly forward on either side so as to be approximately parallel with the great horns of the hyoid. This third piece measures 2.9 cm. on the right and only 1.5 cm. on the left. On the right it is continued to the hyoid by a ligament only some 3 mm. long, which encloses the rudimentary lesser horn. On the left the two nodules are enclosed in a ligament of some 7 mm. The largest diameter is about 6 mm. near the lower end of the first piece on the left. Although certain joints were noted, they disappeared when the specimen was dried. It may be considered practically certain that there was no motion of any importance between the different pieces, excepting in the neighborhood of the hyoid. This peculiarity was happily discovered during the dissection before very much had been removed, so that the subject still had the outlines of a human body rather than those of an anatomical preparation. The X-ray reproduced in fig. 2 was taken as soon as possible. It is, so far as I know, the first of its kind.

CASE 2 (Figs. 3, 4 and 5).—The next case was observed at about the same time. H. 402. Male, black, age unknown but young, apparently about twenty-five. This may be called an instance of very long styloid processes. It was noted during the dissection that they seemed to reach to within one or two centimetres of the hyoid. No stylo-hyoid ligament and no lesser horns could be found. The length is 5.9 cm. on the right and 5.3 cm. on the left; but measurements must often be only approximate from the difficulty of getting a really satisfactory and precise starting point. The condition is quite different on the two sides. On the right the tympano-hyal projects but very little beyond the vaginal process. It is connected by fibrous tissue to a long, slender rod, presenting something of an enlargement at its middle, which marks a change of direction. At first

it runs forward and downward and then inclines inward as well. There is another bend just before the point. On the left the process is much straighter. The tympano-hyal, which is much stronger than on the right, projects far beyond the vaginal process. It is connected by fibrous tissue with the stylo-hyal, which runs downward and forward without change of direction except for a slight bend backward at the end. The tympano-hyal has a very much greater development on the left than on the right, illustrating beautifully the principle that in such variations the same element may be of very varying importance. It is not unlikely that the point on both sides is made by the cerato-hyal, but there is no way of knowing and it is of no consequence. An X-ray was taken of this head also before the dissection was very far advanced. These two cases were seen near the close of 1906.

CASE 3 (Fig. 6)...No. 9993. Male, black, age 28. This specimen was found in the dissecting room a few years ago, during my administration, and was placed by me in the Museum. There is nothing very remarkable about the styloid processes. The feature is the strong ossification of the lower part of the chain; and again the condition is not the same on opposite sides. The arrangement on the right is as follows: the tympano-hyal is not to be distinguished, the stylo-hyal is ligamentous, 2.6 cm. in length, the cerato-hyal is bone. The length is 4 cm. and the greatest breadth, which is at the top, 5 mm. A ligament 4 mm. long connects the lower end of this ossification with the hyoid. There is no lesser horn.

On the left the tympano-hyal projects just beyond the vaginal process. Next to this comes a ligament 5 mm. long, then an ossification, the stylo-hyal 1.3 cm., which is connected by a ligament 3.1 cm. long to the cerato-hyal, which measures 2.8 cm. and is not only much shorter but much lighter than its fellow. The most important difference is at the lower end of the chain. On the left a lesser horn of 4 mm. springs from the hyoid and is connected by a very little fibrous tissue with the lower end of the cerato-hyal.

The two next cases have been for years in the Warren Museum.

CASE 4 (Fig. 7).—No. 6631. Sex, age and race are not given, but I have very little hesitation in pronouncing it male and I incline to think it is the head of a negro. The right stylo-hyal is a thick rod which about 1.6 cm. from its origin expands into a rounded knob. The shaft is thickest in a line running backwards and outwards, measuring 8.5 mm. The transverse diameter is 4.5 mm. Continuous with the thick rod, which has been assumed to be an elongated stylo-hyal, is a long, slender bony process, extending in a somewhat tortuous course downwards and forwards. This apparently was sawn across before it was observed in the dissection. Apart from this obviously artificial division, the bony rod extends 7.7 cm. from the skull (measured in a straight line), ending in a small knob. There is, of course, no means of knowing how this rod was connected with the

hyoid. The attachment shown in the photograph is entirely artificial. There is no lesser horn on either side.

On the left the tympano-hyal projects beyond the vaginal process. It is of about the usual size and has a rough ending as if it had once been covered with non-articular cartilage. This specimen is remarkable for the very large size of the upper part of the rod as well as for its length.

CASE 5 (Fig. 8).—No. 602 was placed in the Museum by Dr. David W. Cheever in 1865 during his service as Demonstrator. There is no statement of age, sex nor color. The chief interest is that the chain differs from all the others. It probably did not come from an aged individual, as the greater horns of the hyoid apparently are not fused with the body. Owing in part to the method of mounting it is very hard to determine whether there is any element that can be called a tympano-hyal. The stylo-hyal is longer on the right and thicker on the left. The cerato-hyal is of about the same length on both sides, but is separated from the preceding piece by a longer ligament on the right than on the left. This condition is reversed below this ossification, the ligament going to the lesser horn being longer on the left. These horns measure each 3 mm. and are fused with the greater horns. Thus there is a general correspondence between the two sides with a difference in details.

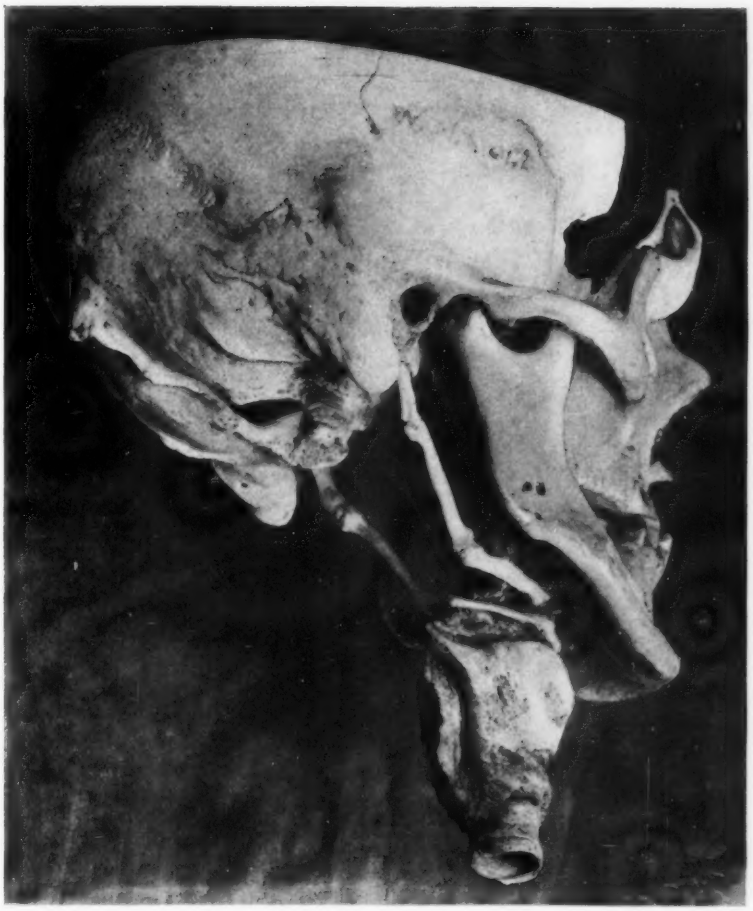
Passing now to cases recorded in literature and without making any attempt at a complete account of all cases observed I give several which strike me as the most interesting and which illustrate the variety of details presented by this abnormal ossification.

CASE 6.—GEOFFROY-SAINT-HILAIRE describes a specimen given him by Serres. The body of the hyoid bone was very large, somewhat resembling that of American monkeys. The greater horns were slender and very wide spread. The first piece of the chain, which he calls the styloid, was long and thick, while the cerato-hyal and the apo-hyal (hypo-hyal) were slender, long and straight and swollen at their ends. The last mentioned was longer by a quarter than the one above it. These two appeared to have been but recently united together, and the same is true of the first piece and the vaginal process, although the man was fifty-six years old. Ligamentous fibres connected the lesser horns with the body of the hyoid. This condition was found only on the right.

The following three cases reported by the late Professor Saturnin Thomas, of Tours, are taken from the paper by Retterer.

CASE 7.—Male, aged thirty. There was a swelling below the vaginal process at the junction of the tympano-hyal (*prolongement hyoidien*)

FIG. 1.

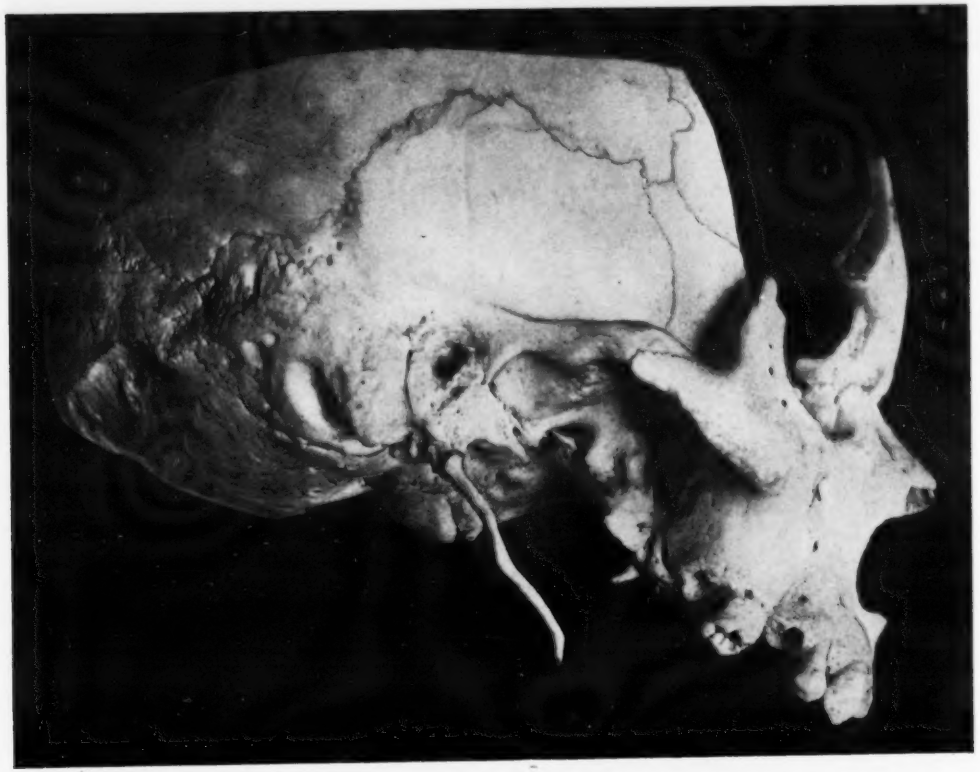


CASE I.

FIG. 2.

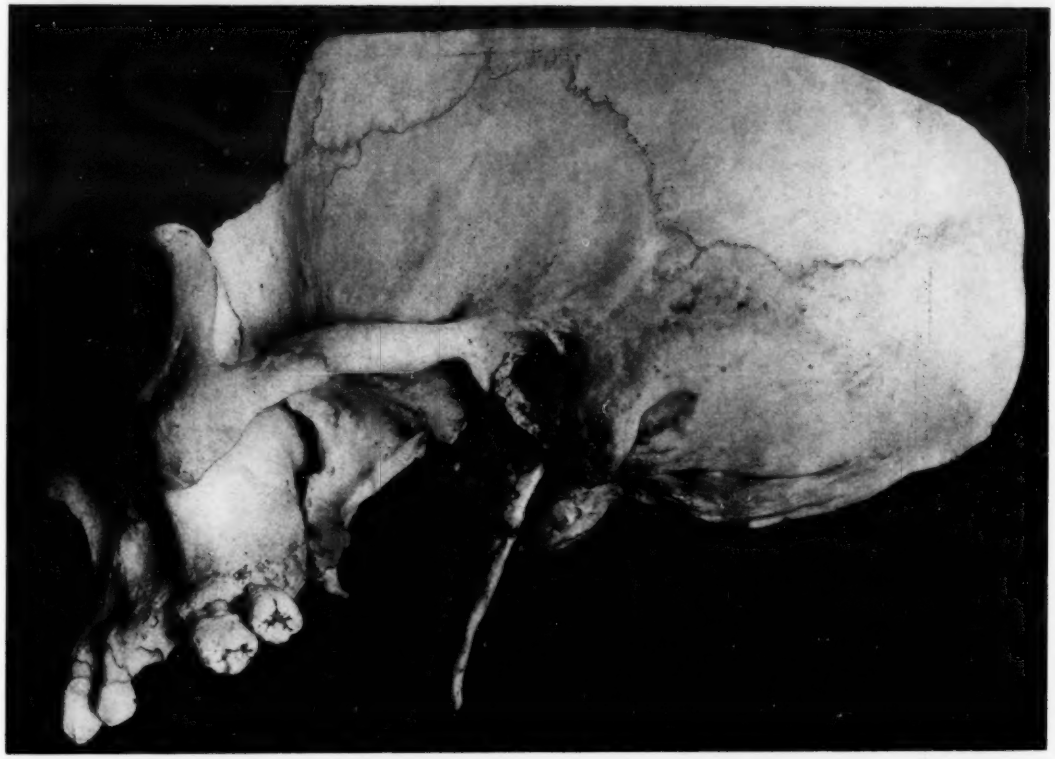
An X-ray of Case I when only partially dissected. The stylo-hyoid chain of one side is shown clearly.

FIG. 3.



CASE II.—Right side. The tympano-hyal does not project beyond the vaginal process. The styloid process, which is not joined to it by bone, probably consists of the stylo-hyal and cerato-hyal.

FIG. 4.

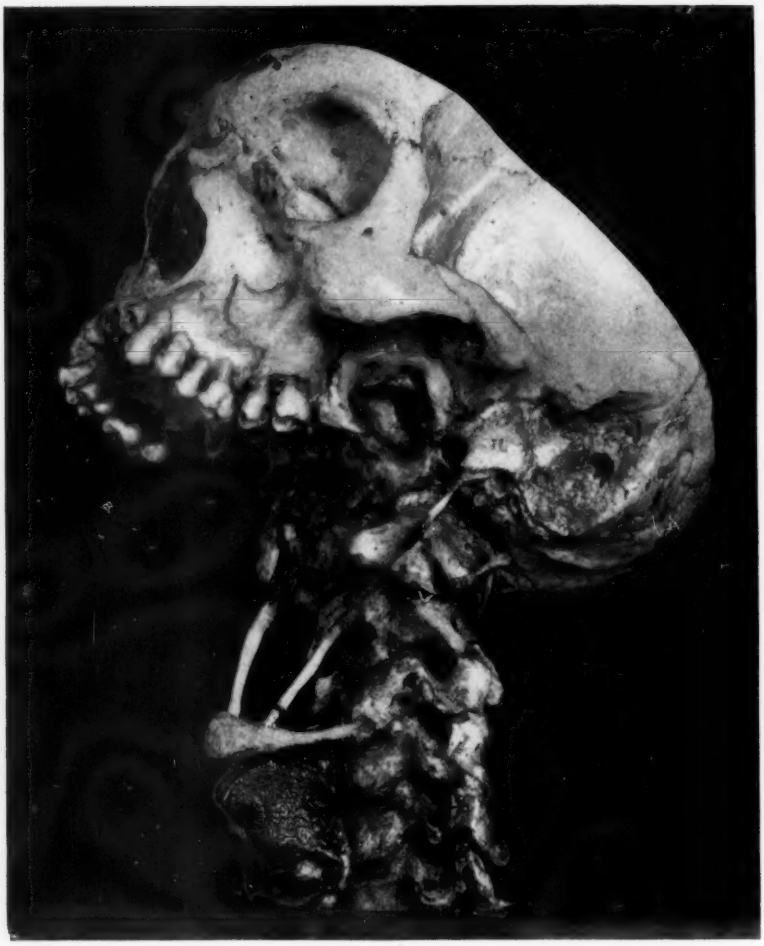


CASE II.—Left side. The strong tympano-hyal is very prominent. There is no bony union between it and the stylo-hyal.

FIG. 5.

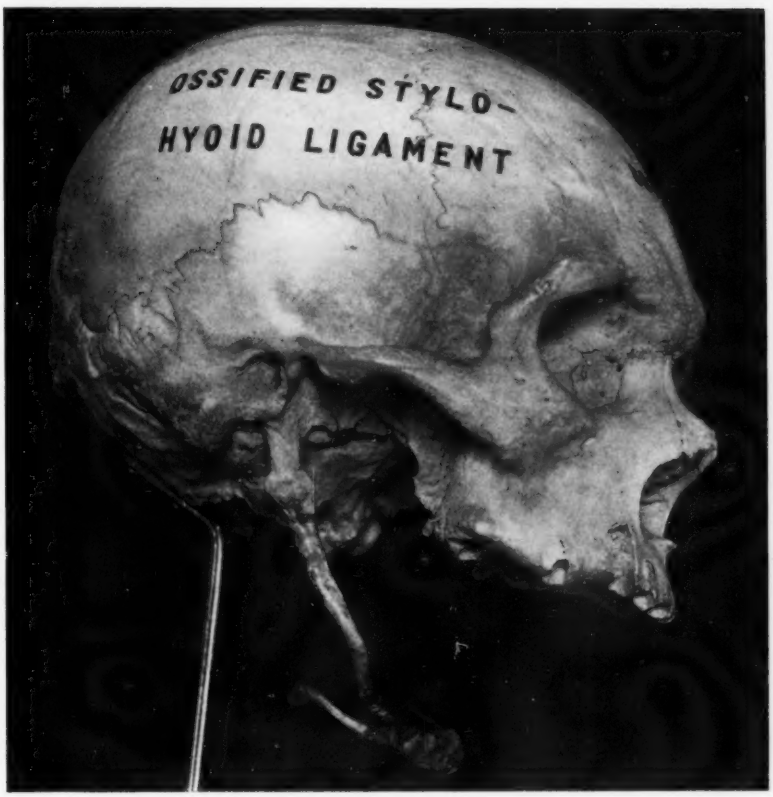
An X-ray of Case II when only partially dissected and before the skull had been divided. Both stylo-hyoid chains are shown.

FIG. 6.



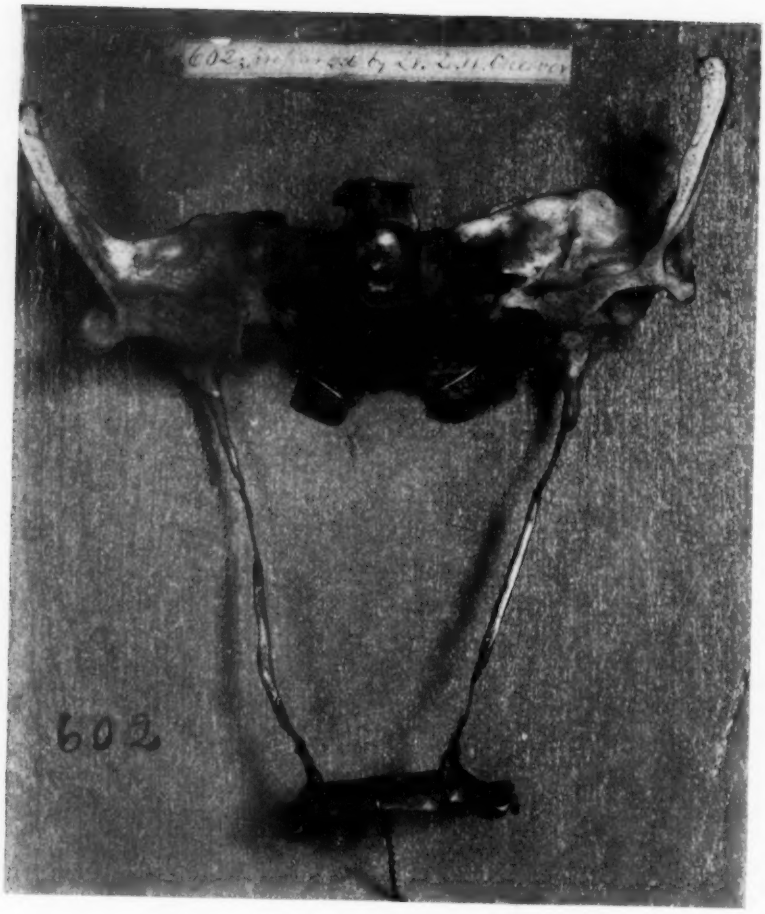
CASE III.—The lower part of the cerato-hyal is a strong bony rod on both sides.

FIG. 7.




CASE IV.—The large first piece is probably an immense tympano-hyal, with which the fused stylo-hyal and cerato-hyal are united.

FIG. 8




CASE V.—The ossification is irregular and asymmetrical.

with the styloid. The lower end of the latter articulated with the cerato-hyal, which was continued by ligament to the hypo-hyal or lesser horn.

CASE 8.—The vaginal process was continuous with the tympano-hyal, of which the lower end was fused with the first piece of the stylo-hyal, which had a fusion at its junction with the cerato-hyal.

CASE 9.—Female, aged fifty. The lesser horn was elongated as in animals. The cerato-hyal was very small and not joined to the piece above it.

No mention is made in the abstract by Retterer as to whether these conditions existed on one or both sides.

CASE 10.—SAPPEY in the third and fourth editions of his Anatomy gives a fine illustration but no description of a case of this kind. Perhaps it is the often mentioned one in the Musée Orfila. Describing it from the drawing, it appears to be essentially symmetrical on both sides. The tympano-hyal projects some distance beyond the vaginal process and ends in an enlargement which meets a similar enlargement of the stylo-hyal. This is the largest point of the bony chain. Below this comes the cerato-hyal, which is connected to the lesser horn by ligament. The drawing represents it as completely fused with the stylo-hyal on the left. In spite of the author's use of the word "*soudure*," the other above mentioned joints would appear from the drawing to persist.

CASE 11.—GRUBER reports an instance of ossification on both sides in an old person, which apparently was observed on a macerated skull. The hyoid apparently had been lost, but the bony rods were so long and came so near together below that one cannot doubt they very nearly reached that bone. The drawing represents them ending in sharp points, which we are told were 11 or 12 lines (say an inch) apart. The two rods were equally long and showed occasional swellings. The left one was rather stronger than the right. Both had a bend near the middle, that in the right one being the greater. The part above the bend was slightly curved on both sides and the lower portion straight.

CASE 12.—POIRIER and MEUNIER had a remarkable case of very perfect ossification of this ligament from a person, sex not stated, of thirty years. The greater horns of the hyoid were remarkable for their size and for the presence of a small nodule at their ends, connected with them by some kind of a joint. The stylo-hyoid ossifications of the two sides were practically symmetrical. They presented the following pieces: the styloid process, a long piece divided into two, showing a swelling and remnant of a suture at the junction of the first and second third; then the little horn of the hyoid, surrounded by fibrous tissue, connecting it both with the last mentioned bone above, and with the hyoid below.

CASE 13.—The following case from a man of sixty-four, reported by MEUNIER is in one respect unique;[1] namely, that the hyoid bone and the (ossified) thyroid cartilage were united. The ends of the greater horns of

[1] This is unique among variations of this class, but Debierre describes a hyoid which had true joints on the under side of the ends of the greater horns to articulate with the tips of the thyroid horns.

the hyoid were connected with the superior horns of the thyroid by joints which apparently once had been true joints. On the right, indeed, the joint was quite lost, being represented merely by a swelling. On the left the joint still existed, but in such a condition that there was no motion on either side. The hyoid in this case was peculiar. The body was large and deeply hollowed. Moreover it was surmounted in the middle by a tubercle projecting towards the muscles of the tongue suggestive of the *uro-hyal* of mammals. The stylo-hyoid chains were not symmetrical. The right one was slender and nearly straight. It consisted of the stylo-hyal, the epi-hyal, which was a small nodule in the ligament from the stylo-hyal, to another long piece which represented the cerato-hyal and the hypo-hyal. A swelling at the lower third marked the point of their union. The left chain was larger and more tortuous. First there was the stylo-hyal joined by a fibrous sheath to a long second piece, 5 mm. thick, which represents both the epi-hyal and the cerato-hyal. The point of union is marked by a swelling at the upper third. This compound second piece ended below in a swelling which rested on the outer end of the body of the hyoid, but leaving room between it and the greater horn for the presence of a detached nodule as large as a pea, which is the hypo-hyal. I infer that the chains were continuous with the temporal bones, but this point is not stated as clearly as could be wished. On the right there was some play between the first and second pieces, and on the left there was more motion at the different joints. It is tolerably certain, as the author implies, that the joints were degenerating and that earlier in life they permitted more motion. The thyroid was abnormally close to the hyoid.

Case 14.—Retterer's case is a very striking one. It was observed on both sides of a man of sixty. The body of the hyoid was very large, with widely diverging greater horns. The two sides differed considerably. On the right the bony rod measured 9.5 cm., with an average diameter of 5 mm. It consisted of two pieces, the upper measuring 2.5 cm. and the lower 7 cm. There was an enlargement at their junction which was surrounded by fibrous tissue and at which some indefinite motion was allowed. The upper piece rested against the vaginal process and was not fused with the temporal; the lower was attached to the hyoid by fibrous tissue. On the left the styloid, 1 cm. long, was fused with the temporal. (Very probably this was the tympano-hyal.) Its lower end was attached movably to the stylo-hyal, 1.5 cm. long, from which a cord ran to the cerato-hyal, 3.5 cm. long. The lower end of this was continued by a ligament of 1.5 cm. to the lesser horn, which measured 2 cm. and was movable on the hyoid. These two chains passed about 2 cm. internally to the ramus of the jaw and were connected with the fibrous tissue covering the internal pterygoid.

The following case by Turner much resembles case 4.

Case 15.—"On the right side of a male subject, the styloid process, 31 mm. long, was from two to three times as thick as customary; and instead of ending in a point, formed an expansion, 13 mm. in antero-poste-

rior, and 9 mm. in transverse diameter. Below, and articulated with it by a movable joint, was a bar of bone, 56 mm. long, which passed downwards to articulate with the small cornu of the hyoid. This bar was thickest at its upper end, and measured 10 mm. antero-posteriorly, and 8 mm. transversely, whilst at the lower end its dimensions were only 4 by 3 mm. The small cornu was somewhat thickened, and had its usual articulation at the junction of the body with the great cornu of the hyoid, which parts of that bone had their customary appearance. When the right arrangement in this neck is compared with the normal condition in a dog, the bar of bone is seen to be the homologue of the epi-hyal bone in this and many other mammals. There was no vestige of a right stylo-hyoid ligament, the place of which had been taken by the epi-hyal."

The left side was practically normal.

CASE 16.—MR. E. T. PORTER exhibited before the Dublin Pathological Society a specimen of abnormal styloid processes which, as he observed, was of more interest from an anatomical than a pathological point of view. They were styloid processes, much longer than usual, and not so firm and osseous, but rather slender and flexible. They were attached to the temporal bone by cartilage, instead of bone, and in the same subject there was no styloid muscle or ligament. They were situated between the carotids, and so placed that it would have rendered ligature of either vessel extremely difficult.[2]

CASE 17.—The following very remarkable case described by KOSTANECKI is unique. It was observed on the left side of a man of sixty-four. A projecting plate of bone turned backward from where the angle of the lower jaw should have been and played against a really immense styloid, by what may be called a false joint or a bursa, but the description is inadequate. The styloid, or more accurately, the stylo-hyoid chain, consisted of two long pieces with a small, flat, rounded piece of bone of irregular shape between them, which was connected by a false joint with each of the others. The first piece was a thick, rounded rod descending from the skull and becoming broader below. The lowest piece, short and thick, was connected by a ligament (which must have been a short one) with the lesser horn. The intermediate piece was surrounded by a dense envelope of fibrous tissue seemingly continuous with the periosteum of the others. The process on the lower jaw was against the joint below the intermediate piece when the mouth was closed. It was learned that the man had had no symptoms during life.

Besides the above, which may be called dissecting-room cases or museum specimens, there are a few clinical observa-

[2] It may be questioned whether this case should have been admitted; for, of course, if we are to record uncommonly long styloids there will be no end to it. But it must be remembered that styloids which deserve to be called "much longer than usual" probably reach very nearly to the hyoid, like those of my second case, as was noted in the dissection and confirmed by the X-ray.

tions on the living. As long ago as 1870 Lücke reported two cases.

CASE 18.—The first was that of a woman of thirty who had long suffered from difficulty in swallowing. An examination of the fauces made both within and without, revealed on the right a long slender process which pressed the tonsil inward.

CASE 19.—His other case was that of a girl of twenty, who also had difficulty in swallowing. Again there was found on the right side a slender, bony process which pressed against the tonsil. It is stated moreover that in this second case it narrowed the posterior nares on the right.

The first and most important deduction to be made from these cases is that the usual term "ossification of the stylo-hyoid ligament" is wrong and misleading. On the contrary, they support the contention that this condition is due to a continued growth and subsequent ossification of the second branchial cartilage. This does not prevent a degenerative ossification from playing a minor part which probably manifests itself most strongly in the destruction of the joints between the different pieces occurring late in life.

The condition is a theromorphic one; that is, one in which parts of the human body show an exceptional structure which is normal in certain animals as a consequence of a common plan of development.

In at least three instances the hyoid was enlarged. In that of Serres "the body of the hyoid was very large . . . the greater horns slender and very wide-spread." In that of Poirier and Meunier "the greater horns of the hyoid were remarkable for their size . . ." In Retterer's "the body of the hyoid was very large with widely diverging greater horns." It is likely that this would have been recorded much more frequently had all the hyoids been examined.

The sex is given in 12 cases. Of these 9 occurred in men (to which might be added one in which I made the diagnosis from the skull) and only 3 in women.

As to the age: 6 were fifty years or more and 6 less than fifty. Assuming that I was right in estimating the age of

my second case at about twenty-five, none of these 6 had reached thirty-one years. It is clear that old age is not a factor.

The condition is usually bilateral. It is so in 10 of these cases, in 5 it is on the right and in 1 on the left. There is no statement concerning 3 instances.

While it may be said that those in which the ossification was found on both sides were in the main symmetrical; yet it is common to find considerable departures from symmetry in the details, such as the value of certain elements of the chain and arrangement and efficiency of certain joints.

The condition of the joints between the different pieces, including the lesser horns of the hyoid, is very uncertain. In many cases it would appear that joints once present had degenerated; but there is no single case in which the hyoid is firmly attached to the chain so that no motion is possible between them. The nearest approach to this is in Meunier's case (13) in which there is a bony connection in an old man between the thyroid and the hyoid, a change, which as mentioned above, probably occurred late in life. In short, there is usually more or less play between different parts of the chain and practically always near the hyoid, sometimes by a joint below the lesser horns and sometimes by a joint or more often a ligamentous connection above.

## III.

The clinical deductions I venture to assume to be the following:

It is to be remembered that a bony rod may extend from the styloid process to the hyoid. It may be slender or thick. In the former case it is at least in early life, more or less flexible and elastic; in the latter it presents enlargements which at first, as a rule, mark the position of joints. This rod passes between the carotid arteries and may interfere with operations for tying them, and with those on the parotid gland which it probably indents on the inner side. Passing by the internal pterygoid, to which it is attached by the fibrous en-

velope of that muscle, it lies against the outer side of the tonsil which it may indent or displace. It evidently would interfere with excision of the tonsil by the tonsilotome or otherwise. Some years ago I received a letter from a laryngologist who had come across such a structure while operating. I believe that others have had the same experience but I know of no instance which has been reported. The displacement of the tonsil may be sufficient to seriously reduce the approach to the pharynx and even to encroach on the region back of the posterior nares.

It may give rise to difficulty in swallowing. In this connection it is worth noting that the two cases observed during life by Lücke were both young. One would think that the trouble would be greater after the solidification of the joints, especially if the joints above and below the lesser horns of the hyoid should be involved, but as yet there is no clinical evidence.

It is not unlikely that the play of one part of the rod on another should give rise to disagreeable subjective symptoms and even to sounds that could be heard by others, although Kostanecki's remarkable case (17) shows that this does not necessarily occur.[3]

A diagnosis may be made by bimanual examination and the X-ray would settle the matter.

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[3] The late Professor Henry J. Bigelow told me many years ago that perhaps the most curious case he had ever seen was that of the "clicking woman," who, I believe, went for advice to the Massachusetts General Hospital, and left not only unrelieved, but without the satisfaction of a diagnosis. As well as I can remember she was troubled by a continual, plainly audible clicking, which seemed to be produced in the region of the larynx.

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# ACUTE DILATATION OF THE STOMACH—GASTRO-MESENTERIC ILEUS.

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In the study of 459 cases of hernia finished in January, 1899 (The Johns Hopkins Hospital Reports, vol. vii), I was not familiar with postoperative or primary acute dilatation of the stomach. For this reason I looked upon the only example of postoperative obstruction in this group of cases as a high intestinal partial occlusion. The patient was relieved, and recovered without a secondary operation.

In May, 1901, I operated for the first time for symptoms of intestinal obstruction following an operation under chloroform narcosis for reducible inguinal hernia. In this instance a loop of jejunum was caught in Treitz's fossa. The patient recovered. In the report of this case (ANNALS OF SURGERY, 1903, vol. xxxviii, p. 806) the possibility of an acute dilatation of the stomach is not discussed.

Later these two cases will be mentioned in the differential diagnosis between gastro-mesenteric ileus and high occlusion of the small intestine.

In March, 1904, my attention was first called to this postoperative complication in a case of appendicitis; here the clinical picture was distinct, the rapid epigastric distention associated with vomiting of large quantities of duodenal and gastric contents, and the rapid prostration differentiated the lesion from a high intestinal obstruction. The autopsy by Dr. Fisher confirmed the clinical diagnosis.

Such a distressing experience called my attention to the literature, which I should have been familiar with before. From now on I kept this postoperative complication in mind.

In September, 1904, when Dr. Sowers told me of the clinical picture of a patient who had died that day in the

surgical ward of the Johns Hopkins Hospital and on whom an autopsy was about to be performed, it was not difficult to conclude that death was due to a gastro-mesenteric ileus. The illustrations (Figs. 3 and 4) were made from my sketches taken at the autopsy. This case, operated upon by Dr. Finney, has been reported by him (Boston Medical and Surgical Journal, vol. clv, August 2, 1906, p. 107).

In July, 1906, I observed for the first time a lesion of the duodenum and the stomach which I think may be looked upon as a primary *chronic* gastro-mesenteric ileus, or chronic dilatation of the duodenum and stomach (see Fig. 6).

In March, 1907, I saw for the first time a case of primary acute gastro-mesenteric ileus. The complication had its onset during the convalescence from a very severe attack of acute articular rheumatism (see Figs. 1 and 2).

In discussing the cases which have come under my observation I feel that the subject can be presented best by first giving in detail the last observed case. Here the clinical picture was unusually distinct, and I was able at the operation and autopsy to investigate the pathologic anatomy.

CASE I, Path. No. 8025, J. D., patient of Drs. Pound and Seegar.

*Primary acute gastro-mesenteric ileus, symptoms three and a half days; onset during convalescence from a severe attack of acute articular rheumatism...The symptoms began directly after the first solid meal, in a patient greatly emaciated and weakened by a long illness. The symptoms consisted of epigastric distention, gastric dilatation and peristalsis, vomiting of large quantities of gastric and duodenal contents, flatness of the lower abdomen and absolute constipation. The leucocytes were 40,000. There was no fever.*

*Operation: great dilatation of stomach and duodenum up to the mesentery, collapse of the small intestines; jejunostomy; death* (Figs. 1 and 2).

I saw this patient on March 11th, 1907, with Drs. Pound and Seegar of Baltimore. The patient was a male, aged twenty-four. He was the only child of rather poorly developed parents and had always been delicate. About six weeks before he was taken

with an attack of high fever associated with great swelling of many joints. The condition was looked upon as acute articular rheumatism. He was critically ill. There was every evidence of some cardiac lesion. After the fever disappeared and the joint symptoms subsided the patient continued to have a very rapid pulse. His emaciation and weakness became extreme. During the beginning of the attack he was given large doses of salicylates.

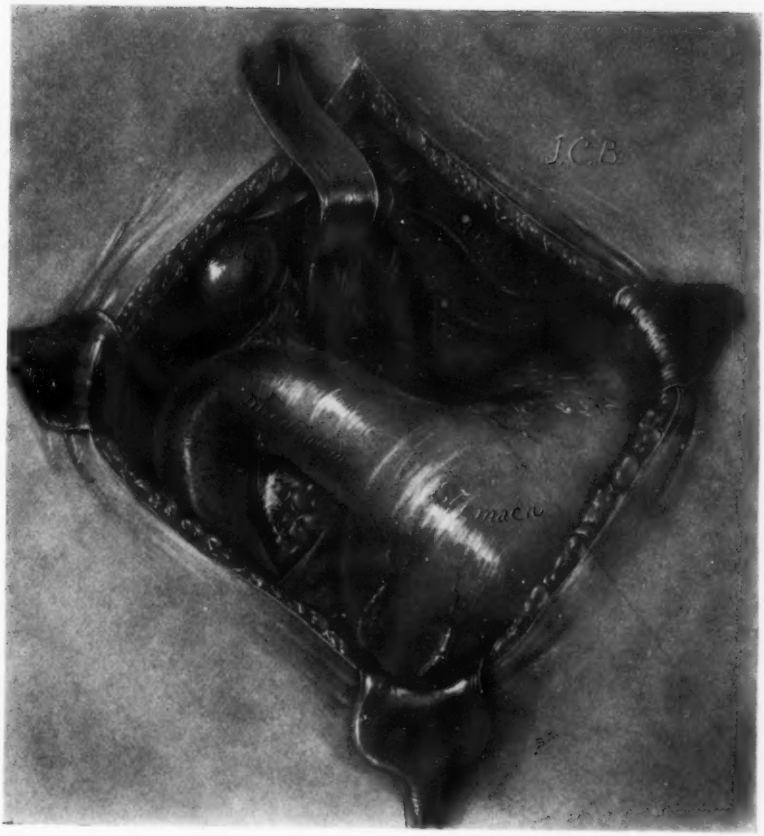
For about a week the patient had been better, the pulse rate had reached normal.

The onset of the acute attack began a few hours after his first meal of solids which included raw tomatoes. I saw the patient three and a half days after the beginning of the symptoms. The clinical picture from the onset had been the same—continuous epigastric distress, with intermittent colicky pains, fullness of the upper abdomen, flatness of the lower abdomen, vomiting of large quantities of a dark brown fluid at irregular intervals. The constipation was absolute; the quantity of urine diminished; there was no fever. The pulse had become more and more rapid. The treatment had consisted of high enemata and cathartics. The stomach tube had not been used.

*Examination.*—The patient is extremely emaciated; although the face is pale and sallow the lips have a bright red color. The pulse varied from 130 to 140; it was very weak. While I was looking at the patient he complained of a colicky pain and vomited about six ounces of a dark brown fluid, which contained mucus and a little blood. This fluid had a sweetish odor and did not remind me of normal gastric contents, but of the contents of the duodenum. As one looked at the albumen there was distention in the epigastrium with an almost scaphoid abdomen below. When the patient complained of a colicky pain one could see a broad peristaltic wave pass from left to right in the area of distention between the costal margin. The distended area was tympanitic, and this tympany extended on the left to the nipple line above and the posterior axillary line behind; less to the right, partially obliterating the liver dullness. On palpation one could not positively make out the stomach because the muscles were held rigid and the patient complained of some tenderness. The lower abdomen however was soft, the rectal examination negative.

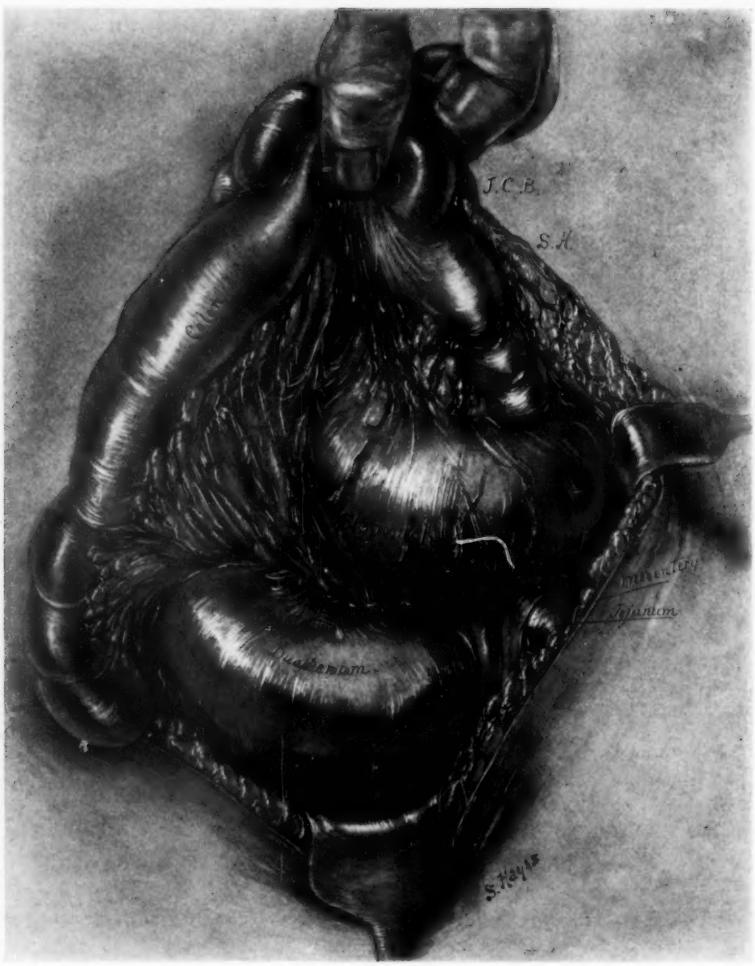
A diagnosis of gastro-mesenteric ileus was made and the possibility of a high intestinal occlusion considered.

FIG. 1




CASE I.—Acute gastric and duodenal dilatation. Appearance of stomach and duodenum at operation. Author's case.

FIG. 2.




CASE I.—Acute dilatation of the stomach and duodenum. Appearance of stomach, lower portion of duodenum, mesentery and collapsed jejunum; transverse colon lifted up. Author's case.

After the patient reached the St. Agnes Hospital the leucocytes were found to be 40,000. During his transportation he continued to vomit and the pulse had increased to 150. On passing a stomach tube at least a litre of dark brown fluid was evacuated. It required at least ten minutes before the washings came away clear. This suggested that there was a dilatation at least of the duodenum as well as the stomach. The patient was given a subcutaneous salt infusion. The distention rapidly disappeared, his pulse improved and he said he was more comfortable. After an observation of one hour the distention returned. I now thought that perhaps the condition might be due to a high intestinal occlusion for which operation was indicated, and for this reason advised exploration of the abdomen. I am now of the opinion that this was a mistake, and that treatment by the stomach tube and salt solution infusion should have been continued. This treatment is the best for gastro-mesenteric ileus, and in this instance, if there had been an intestinal occlusion lower down, an operation three and a half days after the onset upon a patient so critically ill would promise too little to justify the procedure, especially as the symptoms favored gastro-mesenteric ileus. I consider the operation at this time in this case a mistake in judgment.

*Operation Findings.*—When the abdomen was opened through the right rectus under cocaine infiltration an enormously distended stomach presented itself. The lesser curvature was pushed against the liver, the greater curvature below the level of the umbilicus. As the stomach was full of gas it bulged out of the wound like a balloon and I had to push it back into the abdomen to examine the duodenum. The duodenum appeared as a dilated U-shaped tube situated high under the liver; the base of the U lay a little to the right of the gall bladder notch (Fig. 1). I wish to emphasize first that there is no gastroptosis. Although we see adhesions between the duodenum and the gall bladder in the region of a normal mesenteric attachment, these have not produced the obstruction.

The transverse colon was collapsed, and when I lifted it with the omentum out of the wound I exposed the dilated stomach and duodenum (Fig. 2). The duodenum was tense and dilated up to the position of the mesentery. On the other side the jejunum was collapsed. The stomach and duodenum appeared like a

blown-up balloon, the duodenum fixed, the stomach movable. At the position of the junction of the duodenum and jejunum over which the mesentery and its vessels pass, the stomach pressed downwards with great force. There were no adhesions at the position of obstruction, nor could I by compression force anything from duodenum to jejunum. The obstruction was situated directly behind the mesenteric vessels. As shown in Fig. 2 the duodenum, before it passes beneath the mesenteric vessels through the mesentery, curves upwards and then, as it passes through the mesentery and becomes the jejunum, curves downwards, like the letter S. All the small intestines were collapsed, and it did not appear to me that their position was unusual. In many autopsy cases it is noted that the majority of the small intestines is in the pelvis. I could not demonstrate this in my case. It is very difficult to illustrate correctly the exact picture. The operator obtains his view of the duodenum first on the upper side of the colon, then on the lower by pulling the transverse colon up and down. He sees the contrast between the dilated duodenum and the collapsed jejunum by looking first to the left of the mesentery, and then to the right. The greater portion of the dilated stomach does not come into view. The diagnosis of an obstruction at the duodeno-jejunal junction is first suggested by the continuation of the dilatation of the stomach into the duodenum—an entirely different picture from that observed when the obstruction is at the pylorus. The diagnosis is confirmed the moment one lifts the transverse colon and exposes the duodenum and jejunum. In the case under discussion it required less time to see these things and to make the diagnosis, than to describe them.

Finding that I could not compress the contents of the duodenum into the jejunum, although I could pass my index finger through the mesenteric opening, invaginating either duodenum or jejunum, I decided to do a jejunostomy, and pass a tube into the duodenum. This was done with immediate relief. I considered that this procedure was more rapid and met the indications as well as a posterior gastroenterostomy. In addition, it evacuated the duodenum as well as the stomach.

The patient survived the operation about two hours. On opening the abdomen at the autopsy the tube was found in the duodenum which was empty, but still somewhat dilated, the stomach was very much smaller, but still large and practically empty.

Perhaps the duodenum was situated higher than usual in this case, but it seems to me that the high situation could be explained by its great distention and can be excluded as a factor in the obstruction.

Here is an undoubted observation of acute dilatation of the entire duodenum and stomach with no evidence of adhesions and no gross anatomical changes at the duodeno-jejunal junction different from normal. Whether dilatation was primary in the stomach or duodenum could not be established.

CASE II, Pathol. No. 8326, S. H., previously reported by Dr. Finney (loco. cit.).—*Acute postoperative gastro-mesenteric ileus. Death six days after operation (pyloroplasty, Finney's method). Continuous vomiting with rapid pulse after operation. Mouth excoriated by pancreatic juice in the vomitus. Autopsy* (illustrations, Figs. 3 and 4).

The patient was a white female about thirty-five. Three years previously she had an acute attack of an abdominal lesion diagnosed acute gastritis, which had kept the patient in bed for three months. The details of this attack are not given in the history. The patient continued to suffer from epigastric distress and belching after eating. Two months before she was admitted to the medical clinic of the Johns Hopkins Hospital an operation had been performed on some pelvic organ. Since this time the patient has vomited almost daily.

From June 17 to September 7, a period of almost three months, she was under treatment in the medical clinic. The chief symptom was inability to retain food. In spite of attempts at careful feeding and rectal enemata with absolute rest in bed, the patient lost weight and strength, and the blood-count showed a progressive secondary anemia. At no time was it possible to make out a dilatation of the stomach, nor gastric peristalsis. The residuum in the stomach was never more than 75 c.c.; HCl was always absent; the total acidity was low—about 10; lactic acid was present. I emphasize this clinical picture, because it resembles my case of chronic dilatation of the stomach and duodenum.

At the operation by Dr. Finney the stomach was but moderately dilated. The duodenum was situated high under the liver, but there was no kink in the duodenum. The pylorus easily admitted the index finger. There was slight scar formation on

the anterior wall of the stomach near the pylorus. There is no note whether the duodenum was examined to the jejunal junction.

After operation the vomiting was worse. Before operation she had only vomited when given food. After operation she vomited at intervals of from three to six hours. The vomitus was green and then dark brown in color; it excoriated the mouth as if it contained pancreatic juice. Associated with this there was a very rapid pulse—128 to 140. At first there was moderate epigastric distention, but this with the vomiting ceased twenty-four hours before death. The patient had a number of stools, more than one would expect from the nutritive enemata. The stomach tube was passed on the fourth day only: the result is not noted in the history.

Dr. Sowers told me about this patient the day I came on duty at the Hospital. The clinical picture impressed me as one of postoperative gastro-mesenteric ileus. As an autopsy was about to be performed, we immediately went to the pathological laboratory and found that the abdomen had been opened, and the small intestines handled. Dr. Francis who was performing the autopsy allowed me to examine the stomach and duodenum and to make sketches.

The findings were almost identical with those described and illustrated in Case 1, except the stomach was but moderately dilated and was not pressing upon the mesentery; the duodenum was just as distended, but was not situated as high as in Case 1. This is easily explained by the fact that in the Finney pyloroplasty the duodenum is freed and pulled down in performing the suture.

In Fig. 3 the small intestines have been removed: the stomach is not dilated. The characteristic changes in the anatomy of the pylorus after a Finney pyloroplasty are beautifully shown: the dotted lines represent the suture. Just below this in the duodenum there is a kink always observed after this operation, but which has produced no obstruction. The suture had healed perfectly; it was covered with a thin fibrinous exudate and slightly adherent to the liver. The dilatation of the duodenum and its marked U-shape is well shown, and should be compared with Fig. 1. When I cut away the transverse colon and the small intestines the dilatation of the duodenum up to the mesenteric vessels, and the collapsed jejunum forming the S-curve were distinctly seen, and are shown in Fig. 4, which should be compared

FIG. 3

CASE II.—Acute dilatation of stomach and duodenum after a Finney gastroduodenostomy; drawing made from sketch by author at autopsy. Small intestine cut away.

FIG. 4.

CASE II.—Same as Fig. 3; transverse colon cut away. Note relation of mesenteric vessels to position of obstruction.

with Fig. 2. When I cut the jejunum near the mesentery it was empty and nothing escaped. When I pressed upon the duodenum there was no leakage. But when I passed my index finger through the jejunum into the duodenum a large quantity of thin, brown fluid escaped, and the duodenum collapsed. At operation, therefore, in Case 1, and at autopsy in Case 2, compression of the duodenum could not force its contents past the obstruction behind the mesenteric vessels into the jejunum. It seemed to me there was a valve-like kink due to the tension of the distended duodenum, and not to traction on the jejunum by the weight of the small intestines—an explanation quite frequently given in the literature.

CASE III, Pathol. No. 7442, Mrs. R.—*Chronic gastro-mesenteric ileus, or chronic dilatation of duodenum and stomach. Exploratory laparotomy. Death in twenty-seven days. Partial autopsy.* Illustration, Figs. 5 and 6, of findings at operation.

This patient, a white female aged forty-two, was referred to me by Dr. Carr. She was a married woman and until a year ago had been comparatively well. She dates her illness, however, to an attack of mumps from which she suffered about two years ago. During her convalescence she suffered from abdominal pain and nausea which have been present off and on since. During the last year she has had five acute attacks, the last five weeks ago. These attacks consist of pain in the left side of the abdomen with nausea and vomiting. The severe attacks last about three days and are relieved by calomel. Between the attacks the patient suffers with indigestion and belching. With the last attack, five weeks ago, there was diarrhœa.

*Examination.*—The patient is thin and not well nourished, restless, nervous and unusually apprehensive. Nothing is to be made out in the abdomen, except resistance in the epigastrium and a somewhat indistinct mass situated between the umbilicus and costal margin on the right side. This mass has somewhat the shape of a pigeon's egg and is about 5 by 2 cm. in diameter. It could be moved (Fig. 5) from side to side, but not from above down. It was slightly tender on pressure.

In view of the age of the patient and the palpable mass an exploratory laparotomy seemed justifiable.

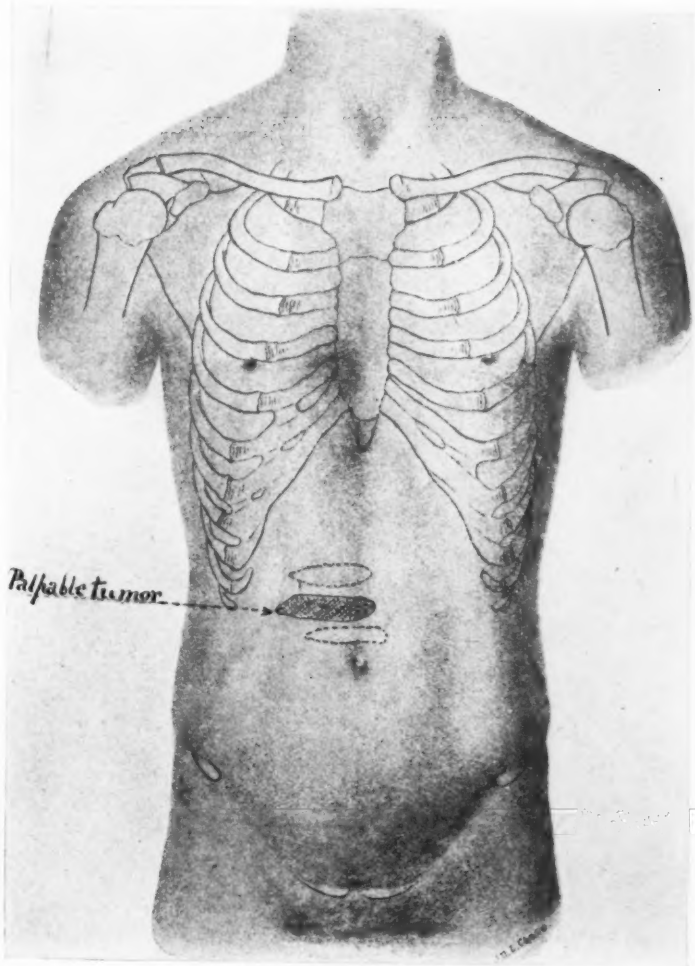
On opening the abdomen there was practically no subcutaneous fat and very little fat in the omentum. The stomach was but moderately dilated. There was no obstruction or scars

in the region of the pylorus. The condition that at once struck the operator as unusual was in the duodenum and pancreas (Fig. 6). The duodenum was a dilated, U-shaped organ extending high up under the liver and surrounded the pancreas. The duodenum and pancreas were unusually movable, the latter felt hard and indurated, the duodenum, although somewhat dilated, was soft and compressible. There were no adhesions. The third portion of the duodenum was less movable, and of about the same caliber. The entire small intestines were unusually small and ribbon-like—a condition which I have observed in a few instances when the abdomen had been opened in patients who had taken little food for a number of weeks (starvation atrophy). The enteroptosis of the stomach was but slight. The duodenum and pancreas, although quite movable from right to left, could not be pushed down, nor could I pull the duodenum out of the abdominal wound. In my only laparotomy for extreme gastroptosis I found that I could lift the duodenum and pyloric end of the stomach out of the abdominal wound as easily as a loop of small intestine. In this case the duodenum, although dilated throughout, was compressible, and there was no evidence of any accumulation of its contents. Yet the contrast between the duodenum and the jejunum as to caliber was unusual.

I have never met with, nor read of, a similar condition, and as at this time I was somewhat prejudiced against the posterior gastroenterostomy without definite indications, I closed the abdomen. In the case of gastroptosis just mentioned, the duodenum was almost as dilated and the contrast with the jejunum almost as great. As this patient had made a splendid recovery without posterior gastroenterostomy, after rest in bed and daily use of the stomach tube, I felt that the patient in Case 3, should do as well.

After operation nausea and vomiting were prominent symptoms, but there was absolutely no distention in the epigastrium, no dilatation of the stomach, no peristalsis of the stomach: the vomiting now and then contained bile; there was never any evidence of pancreatic juice; the bowels moved normally. For a few days the patient would take food, then there would be a recurrence of the inability to retain even water. Mentally, the patient was extremely depressed and apparently made up her mind to die. The intervals of slight improvement with ability to

FIG. 5.




CASE III.—Diagram of palpable abdominal tumor.

FIG. 6.

CASE III.—Chronic dilatation of stomach and duodenum. Sketch from operation findings. Author's case.

retain food for a few days encouraged the postponement of a posterior gastroenterostomy. The patient died suddenly the morning of the day selected for the secondary operation, five weeks after the primary operation. Dr. Carr was able to get an autopsy only after the body was embalmed, and the findings were the same as at the exploratory laparotomy. The embalming fluid prevented properly stained sections of the pancreas. There seemed to be, however, slight interstitial pancreatitis; the stomach and duodenum were practically normal.

These are the only three cases in which I have fairly complete operative and autopsy findings.

In all three cases the obstruction began abruptly at the junction of the duodenum and jejunum, beneath the mesenteric vessels. In Case 1 the duodenum and stomach were tremendously dilated, the duodenum fixed in a high position. In Case 2, at operation, the stomach and duodenum were moderately dilated; there was no positive evidence of pyloric obstruction; the duodenum was not examined in its third portion; at the autopsy in this case the duodenum was dilated down to the mesentery, the stomach was only moderately dilated. In Case 3 the duodenum and stomach were but moderately dilated, but the duodenum, except in its lower third, was abnormally movable. Case 1 is a typical example of primary acute dilatation. We know nothing about the condition of the stomach and duodenum before the attack. Cases 2 and 3 give a clinical history which resembles a gastric neurosis more than pyloric stenosis or ulcer. I am of the opinion that chronic dilatation of the duodenum was present before operation in both cases (2 and 3). In Case 2 the condition became acute after operation. There is no evidence that the pyloroplasty was a factor in its production, and there is every reason to believe that this pyloroplasty did not and could not relieve the original condition. In Case 3, the exploratory laparotomy had no effect whatever on the clinical picture. In this third case the stomach was washed out two and three times a day; this procedure may have prevented acute dilatation, but it had no curative effect upon the chronic condition.

Theoretically, posterior gastro-jejunostomy with a short loop may have been indicated in both cases. This procedure would have relieved gastric stasis, but might have increased the duodenal dilatation. Theoretically, also a second anastomosis between the duodenum and jejunum would have to be performed to drain both duodenum and stomach. Future experience may demonstrate that in cases of this character a simple duodeno-jejunostomy is indicated. This operation, as far as I know, has never been done, nor even suggested before. It certainly meets the indications better than gastro-enterostomy and is simpler than a combined gastro-enterostomy and duodeno-jejunostomy.

In all three cases the small intestines were collapsed, with absolute constipation in the first case, but some movement of the bowels in the other two cases. In none of these cases can it be positively said that the small intestines were in the pelvis. In the two cases which I observed at operation (1 and 3) the majority of the small intestines were not in the pelvis. Free fluid in the peritoneal cavity was absent in all, and there were no adhesions and no gross anatomical lesions to explain obstruction at the mesentery. Nor was I able to ascertain whether the dilatation of the stomach was primary or secondary.

As stated before, I am of the opinion that in Case 1 the stomach tube should have been used for a longer interval before the patient was subjected to operation; it also should have been employed by his attending physician from the onset of the disease. In Case 2 operation was indicated; the patient had been given the benefit of the best medical treatment, during which time she lost strength and flesh and became more anemic. After operation here, the stomach tube was not employed as it should have been, once or twice a day or more frequently. In Case 3 the palpable tumor was sufficient indication for exploration. In the postoperative treatment nothing was neglected. Whether this patient could have been cured by a duodeno-jejunostomy, remains to be answered by future experience in other cases.

FIG. 7.

CASE IV.—Acute postoperative dilatation of the stomach. Finney's case. Photograph from alcohol specimen.

CASE IV, Pathol. No. 7352.—*Acute postoperative gastric dilatation (following a Finney gastro-duodenostomy), associated with pregnancy. Death one month after operation* (Fig. 7).

This case I have published with the illustration in the *International Clinics* (April, 1907, page 285, Fig. 27). The patient was a white female, aged twenty; for six months she had suffered from indigestion consisting of epigastric pain and nausea. For two weeks the symptoms had been very severe, with vomiting. There had been and still was discomfort directly after taking food, and vomiting two to three hours later. On one occasion blood was in the vomitus. No improvement under rest and milk diet. On examining the abdomen nothing was made out, except slight resistance and tenderness in the epigastrium. In the gastric secretion there was no HCl, and a total acidity of 28. The patient did not improve after a month's medical treatment. Pregnancy was denied and no pelvic examination made. At the operation by Dr. Finney the stomach was found to be but moderately dilated, the pylorus was slightly constricted: there was no definite scar tissue, but a few adhesions about the pylorus. The pylorus seemed higher than normal, and it is noted that the duodenum was contracted.

A Finney gastro-duodenostomy was done. After operation the patient's condition on the whole was worse—continuous vomiting, which excoriated the mouth; slight jaundice and bile in the urine. The possibility of pregnancy was then admitted by the patient.

*Autopsy.*—The dilatation is confined to the stomach with a kink in the lesser curvature which, however, did not obstruct the pylorus (see Fig. 7). The pyloroplasty wound had healed: the small intestines were contracted; the adhesions between the pylorus and liver noted at the operation were still present.

The fetus in the uterus indicated a four months' pregnancy.

Evidently this is an example of acute gastric dilatation following operation, yet at autopsy there was no evidence of pyloric obstruction. The note, however, on the duodenum, both, at operation and autopsy, is not sufficiently explicit to exclude duodenal dilatation. In the specimen sent to the laboratory there is but a small piece of duodenum: this is dilated.

As the patient gave a history of six months' gastric discomfort, was under treatment one month before operation, and died one month after it, the gastric symptoms antedated the pregnancy four months. The marked nausea and vomiting were of but two weeks' duration and therefore coincident with the sixth week of pregnancy. At the operation there was sufficient pyloric stenosis to explain the gastric symptoms. My colleague, Dr. Williams, professor of obstetrics, tells me that he has never observed acute dilatation of the stomach in the vomiting of pregnancy. He recognizes two forms of vomiting in the gravid woman: the first—of neurotic origin—is usually cured by suggestion; the second—toxic—is only relieved by immediate evacuation of the uterus. The liver in this case, in gross and microscopic study, did not have the appearance of that observed in the toxic vomiting of pregnancy. For this reason we must look upon this case as an acute postoperative gastric dilatation, and in view of the large opening between the duodenum and stomach made by the anastomosis, we can exclude pyloric stenosis as a factor. Although unfortunately the autopsy record does not allow us to make positive statements with regard to the duodenum, I am inclined to the view that this case is identical in its etiology with the three already discussed.

Case V, Pathol. No. 608, J. O.—*Postoperative acute dilatation of the stomach secondary to appendectomy, drainage, and enterostomy for perforating appendicitis with general peritonitis and intestinal obstruction. The patient died twelve and a half days after operation.*

This patient, referred to me by Dr. Murphy of Annapolis, a white male, aged twenty, was operated on in the fourth day of an attack of acute appendicitis: the appendix, situated in the pelvis, was perforated; there was pelvic peritonitis with a considerable collection of pus requiring pelvic drainage. Two and a half days later an enterostomy had to be performed for obstruction due to the pelvic peritonitis.

The patient did very well for a number of days. The upper tube drained well, but the loop seemed to be short, because the discharge consisted of material but slightly digested. As the

patient grew weak it was necessary to rather force the nourishment by mouth. On the fifth day after the second operation the patient had sudden epigastric distention, and in a few hours the pulse rose from 106 to 120: at the end of four hours he vomited 300 c.c. of fluid with immediate relief: the epigastric distention disappeared, the pulse improved, the vomiting ceased, and the tube began to drain again. In my notes made at that time I looked upon the condition as an acute gastric dilatation due perhaps to forced feeding in a patient weakened very much by his disease. On the ninth day, four days later, there was a second attack with syncope; as the vomiting had entirely relieved the distention the stomach tube was not used. After this attack the general condition of the patient became worse; we could not use the lower loop for feeding, as the obstruction was not completely relieved; the rectal enemata were not well retained; we were therefore forced to employ feeding by mouth. At five o'clock on the afternoon of the eleventh day there was no epigastric distention and no vomiting: this had been absent for forty-eight hours; the patient was taking moderate nourishing without nausea; the pulse, however, was rapid. Within a few hours he began to distend and vomit. Dr. Fisher, who was looking after the patient, attempted to pass a stomach tube, but it had such a serious effect upon the pulse that he considered it wiser to desist. The patient died in collapse a few hours later.

At the autopsy by Dr. Fisher the peritonitis had subsided. The enterostomy was about fifteen feet from the stomach: the intestines below this were adherent in the pelvis; there was no obstruction between the enterostomy and the duodenum; the stomach was enormously distended with fluid and gas. No special note was made upon the condition of the duodenum.

This case can be looked upon as one of acute postoperative gastric dilatation. There were no gross changes or adhesions in the region of the stomach to suggest pyloric stenosis. Whether the gastric dilatation was associated with a similar condition of the duodenum up to the mesentery cannot be positively stated.

CASE VI, Pr. Surg., No. 1483, J. F.—*Postoperative acute dilatation of the stomach following radical cure of left inguinal hernia under ether narcosis. Stomach tube. Recovery.*

White, male, aged fifty-eight. This patient gave no previous history suggesting any gastric trouble. He was, however, a thin,

delicate looking man, and as the left inguinal hernia was a large one, he was carefully prepared for operation. This preparation consisted of, first, a saline cathartic: then forty-eight hours' rest in bed on very light diet; no further catharsis, and effectual rectal enemata on the morning of the operation. The sac contained omentum which was reduced; the Trendelenburg position was employed for about twenty minutes.

After operation the patient very quickly had epigastric distention and discomfort; the zone of tympany indicated that the chief distention was due to the stomach; there was no vomiting; the pulse was good and the leucocytes were but 10,000 (in Case 1 the leucocytes were 40,000). This patient was given immediate relief when the stomach tube was passed, but nothing was obtained except gas; the stomach was washed out: the water came away clear. On washing out the stomach one evening Dr. Smead, in charge of the patient at the Union Protestant Hospital, introduced some castor oil. The next morning the oil was still in the stomach. During forty-eight hours the stomach tube was passed about four times. No cathartics were given except the castor oil mentioned. Sixty hours after operation the patient passed gas and fecal matter per rectum for the first time, after an enema. From now on there was very little epigastric distention or distress. The stomach tube was passed on only two occasions in the next five days.

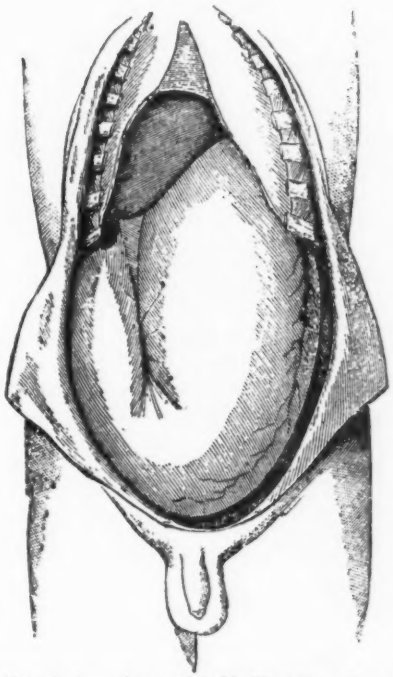
The stomach tube, after operation, is not only valuable in the treatment of postoperative gastric dilatation, but also in diagnosis. If one finds in the stomach intestinal contents, this may be looked upon as an almost positive sign of intestinal obstruction or gastro-mesenteric ileus.

Some six months later this patient was again operated on for a small right inguinal hernia associated with undescended testicle. In view of the previous complication local anæsthesia with cocaine was employed. After this operation the same symptoms appeared, slighter in degree and of shorter duration, and were again relieved by the stomach tube. On both occasions there was no accumulation of fluid in the stomach. The distention was entirely due to gas.

It seems unnecessary to lengthen this article by a long discussion of the literature. *Finney* has presented the subject

in a very systematic manner in the Boston Med. & Surg. Journal, August 2, 1906. *Halstead* of Chicago (Surgery, Gynecology and Obstetrics, vol. ii, 1906, p. 13) reports an observation of his own in which the patient died after an operation consisting in fixation of the kidney. In this case the stomach and first portion of the duodenum were dilated; the obstruction was situated in the descending limb of the

FIG. 8.



Acute primary dilatation of stomach associated with retroperitoneal duodenal abscess. Copied from Fagge.

duodenum as it passed beneath the peritoneum. Other cases with obstruction at this point have been reported; the huge stomach was somewhat V-shaped, like in Finney's case (Fig. 7).

In the *International Clinics* for April, 1906, p. 285, and April, 1907, p. 284, I have given a brief résumé of the more recent literature.

WICHERN (Mittheilungen a. d. Grenzgeb. d. Med. u. Chir., 1906, vol. xvi, page 791) is the first to record this complication during the acute stage of typhoid At the autopsy in his two cases there was no dilatation of the duodenum, differing, therefore, in the anatomical findings from my Case 1. This complication has been observed during the convalescence from typhoid and in the acute stage of pneumonia and scarlet fever.

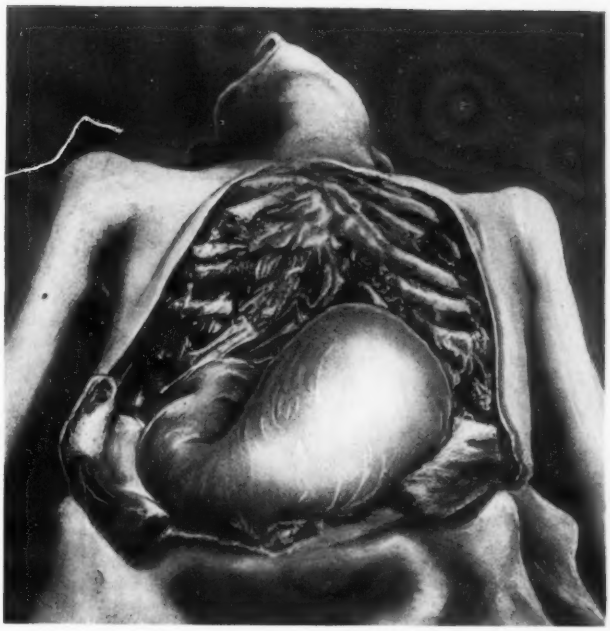
In C. HILTON FAGGE'S original communication (Guy's Hospital Reports, series iii, vol. xviii, 1872-3, p. 1), to which all writers refer as one of the earliest contributions to the subject, there is no note on dilatation of the duodenum. The V-shaped appearance of the hugely distended stomach is shown in Fig. 8, copied from Fagge. His two cases were not post-operative, but primary. In Fagge's Case 1 the cause of the obstruction was a retroperitoneal abscess communicating with the duodenum, probably due to perforating duodenal ulcer. In his second case there was no demonstrable cause for the obstruction.

Fig. 9 is copied from THOMSON (The Lancet, 1901, vol. ii, p. 1113). It illustrates the V-shape of the hugely dilated stomach, which was observed at autopsy, the patient also suffering from acute lobar pneumonia and pleurisy. In this case the dilated stomach reached the pubes. There is no note on the duodenum. The autopsy record simply states that the small intestines were collapsed.

Fig. 10 is copied from a second communication by THOMSON (The Lancet, 1902, vol. ii, page 287), and illustrates the autopsy of a case of acute dilatation of the stomach associated with dilatation of the upper eight feet of the small intestines. The complication began just before the birth of the sixth child of the patient and continued after it. The patient died about forty-eight hours after labor. The autopsy revealed purulent peritonitis from a ruptured ovarian abscess.

Thomson uses this case as evidence against the view that in acute dilatation of the stomach and duodenum the distention begins at the mesentery, and that the lesion is a gastro-duodenal mesenteric ileus. There is no doubt that acute dilatation of the stomach has been observed to cease at the pylorus, in different portions of the duodenum, and, in a few instances, to extend below, into the jejunum. However, in the majority of cases the dilatation ends at the mesentery. I must agree with Thomson that this finding does not prove that the primary dilatation is in the duodenum, and that the mesentery is the etiological factor in the obstruction. Nevertheless, for practical purposes, it seems best to look upon this lesion as a gastro-duodenal dilatation, and if treatment by the stomach tube fails, not to neglect, at the operation, a careful exploration of the duodenum.

FIG. 9.



Acute primary dilatation of the stomach associated with pneumonia. Copied from Thomson.

FIG. 10.

Acute dilatation of the stomach associated with the dilatation of the upper eight feet of small intestine and peritonitis. Copied from Thomson.

If the dilatation ends at the pylorus gastrostomy or gastro-jejunostomy should be performed. If the dilatation involves the duodenum, I would advocate jejunostomy as employed in my first case, or duodeno-jejunostomy.

*The Differential Diagnosis between Acute Gastro-duodenal Dilatation and High Obstruction of the Small Intestines.* In view of the fact that in the first lesion the consensus of opinion favors treatment by the stomach tube and position of the body (knee-chest, or left lateral with elevation of the pelvis), and that in the second lesion immediate operation is indicated, it seems important to ascertain, if a differential diagnosis is possible.

High intestinal obstruction is about as rare as acute dilatation of the stomach and duodenum. The following cases which I have observed apparently demonstrate that a differential diagnosis is possible.

CASE VII.—*Postoperative intestinal obstruction, loop of jejunum in Treitz's fossa. Operation. Recovery.* (*Previously reported in Annals of Surgery, vol. xxxviii,* 1903, p. 807).

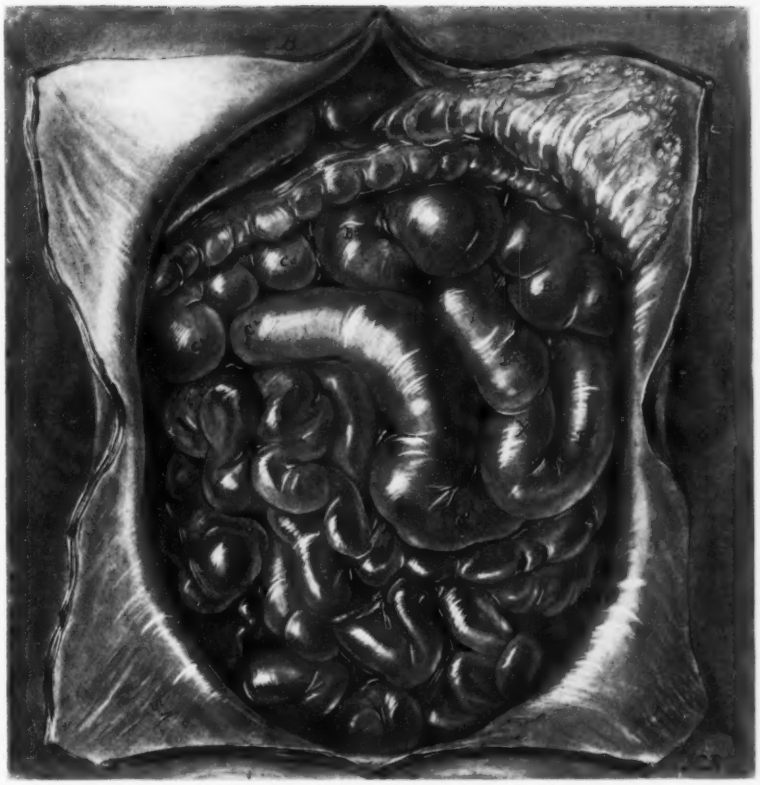
As an etiological factor, it is of sufficient interest to know, that this patient—a physician, aged fifty—dosed himself with cathartics for thirty-six hours before operation and then, a few hours before operation took paragoric to check the diarrhœa. The operation was a simple one for an oblique, reducible inguinal hernia. The dissection was begun under cocaine and completed under chloroform. Vomiting with intense retching began the moment the patient came out of the narcosis and continued. The vomitus was at first bile-stained and later had the odor and contents of the jejunum. There was never acute pain, but general abdominal discomfort. Forty-eight hours after operation I noted that there was moderate asymmetrical distention of the right upper abdominal quadrant with increasing obliteration of the liver dullness. There was not the epigastric distention and distress observed in acute dilatation of the stomach. With the rectal tube some gas and fecal matter came away. The leucocytes rose from 12,000 to 16,000. There was no collapse. In Case 1 of acute dilatation of the stomach the leucocytes were 40,000 and collapse was marked. In view of the increasing obliteration of

the liver dullness and the vomiting of distinctly fecal matter the abdomen was opened fifty-six hours after the first operation. There was no free fluid. On manipulating the small intestines I found some distended and then I withdrew a loop with a definite constriction. The distention extended to, and abruptly ended at, the constriction; beyond this the intestines were collapsed. The constriction seemed to be in the lower portion of the jejunum and had the appearance as if the bowel had been impacted in one of the anatomical fossæ within the peritoneal cavity.

CASE VIII, Pathol. No. 7005, T. W. S.—*Acute intestinal obstruction due to the impaction of a bolus of food. Operation two and a half days. Death.* (Figs. 11 and 12.)

The clinical history in this case suggested acute dilatation, but the physical signs were those of high intestinal obstruction. The patient was a physician, aged sixty-nine, an unusually strong, robust, fat man. The symptoms began some hours after an unusually large Christmas dinner. He was first uncomfortable all over the abdomen, then there was localized pain on the left side between the umbilicus and the tenth rib. Twelve hours after this heavy meal the pain was so intense that he became nauseated; later vomiting, which within twenty-four hours became fecal in character. I saw the patient two and a half days after the onset. The pain had been less the last twenty-four hours, the vomiting of fecal matter continued. The patient did not look very sick; the pulse was 90°. There was no epigastric distention. The liver dullness was not obliterated. There was a distinct area of dullness and fullness in the left flank which was replaced by tympany when he turned on the right side. Although the character of the vomitus resembled that of Case 1 of acute dilatation of the stomach and duodenum, the physical signs of the abdomen were entirely different. When I washed the stomach out it contained but half a pint of distinctly fecal matter, and the washings were quickly clean. In my note made at that time I said: "This small quantity of fluid in the stomach would almost exclude acute gastro-duodenal dilatation and favor obstruction in the small intestine.[11] Later I made out in the small intestine distinct peristaltic waves of the ladder pattern entirely different from the single broad peristaltic wave observed in Case 1. On opening the abdomen there were some clear fluid and distended small intestines; the stomach was contracted, the colon collapsed (Fig. 11).

FIG. 11.



CASE IX.—High intestinal obstruction; dilatation of upper portion of jejunum, not associated with dilatation of duodenum and stomach. A, $B^1$, $B^2$, $B^3$, $B^4$, $C^1$, $C^2$, $C^3$, $C^4$=dilated jejunum; X=position of foreign body behind this loop. Sketch at operation. Author's case. (Scheme copied from Broedel's illustration in Kelly's Operative Gynecology.)

FIG. 12.

CASE IX.—Position of foreign body and appearance of enterospasm. Author's case.

On pulling out the small intestines from the cecum up I encountered, first, a collapsed loop, then a movable foreign body 5.5 cm. long and 2.5 cm. in diameter (Fig. 12); just above this the intestine was constricted, and appeared as if in my manipulations the foreign body had been slightly dislodged; above the constriction the intestines were dilated. The enterolith was soft and could be easily crushed and pushed on. The constriction had the appearance of a local enterospasm and soon disappeared.

The patient died thirty-six hours after operation of anuria and symptoms of autointoxication. There were a number of stools after operation, but the patient continued to vomit some. The autopsy findings differed very little from those at operation. Apparently there had been complete small-intestinal paralysis. The point of obstruction could not be found, but as I had made an enterostomy to evacuate the distended small intestines above the constriction, I could locate its position. It was situated in the third portion of the jejunum. The latter and the duodenum were distended with fluid contents, and this distention with fluid was found eight feet below the point of obstruction. Beyond this the small intestines were somewhat contracted, demonstrating that intestinal contents had begun to move down. The stomach was not dilated. There was very little difference between the sizes of the jejunum and the duodenum on each side of the mesentery. There was no peritonitis.

CASE IX.—*Intestinal obstruction from impacted gall-stone in the jejunum. Operation in forty-eight hours. Death.*

R. J., white, female, aged eighty (patient of Dr. Hamburger). The symptoms of intestinal obstruction were distinct—initial pain and collapse, vomiting, later becoming fecal. As the patient became more toxic the pain became less. At my examination forty-eight hours after the onset, there was no epigastric distention or distress; there was very little abdominal distention; the vomiting was small in quantity and distinctly fecal. Peristaltic waves could not be made out. The leucocytes were 18,000; the patient's pulse was rapid and weak. On opening the abdomen a gall-stone was found impacted in the lower portion of the jejunum or the upper ileum. The stone was removed, the bowel evacuated, the enterotomy wound closed. The patient died a few hours later.

CASE X.—*Acute intestinal obstruction by band. Operation on the third day with enterostomy. Recovery.*

In this case acute dilatation of the stomach was not even suggested by the history, and the symptoms of intestinal obstruction were somewhat obscure. The patient was a healthy male, aged thirty-four, fat and a large eater. The symptoms began with abdominal discomfort and constipation. The initial acute pain and shock of high obstruction were absent. Later colicky pain characteristic of peristalsis were felt. Vomiting was present at rather long intervals. On the second day he vomited a pint of dark-brown colored matter. The distention of the abdomen was uniform and moderate. I was asked to see this patient on the third day by Drs. Thayer and Hammond. He was in excellent condition: the abdomen was but moderately distended; if peristalsis was taking place it could not be seen, as the patient was very fat. Obstruction indicated by the fecal vomiting was thought to be in the small intestine, as there was but little distention, although the history of constipation, colicky pain and late vomiting is that usually observed in obstruction of the large intestine. About the umbilicus there was an area of impaired resonance—a physical sign of fluid in the small intestine. The stomach tube brought away a large quantity of fluid of intestinal odor. On opening the abdomen, the upper portions of the small intestines were greatly distended; the obstruction was due a band in the pelvis below which the ileum was collapsed. As the band was divided the fluid contents passed. In view of the long duration of the obstruction the intestines were opened and evacuated, the opening sutured to the wound and closed for later drainage; this was again opened twenty-four hours after operation. The fecal fistula was sutured at the end of five weeks.

These cases demonstrate that the symptom-complex and the physical signs of high occlusion of the small intestine differ from acute gastro-duodenal dilatation. There are two symptoms in common—vomiting, and its fecal character. If my memory is correct, the odor of the vomitus which I carefully studied in Cases 1 and 6 (acute dilatation of the stomach) is less fecal in character than when the obstruction is in the small intestine. The character of the vomiting, however, is not sufficiently different to allow a differential diagnosis. In high intestinal occlusion initial pain accompanied, perhaps, by peritoneal shock which may later somewhat disappear, and

vomiting without marked distention are the symptoms which differentiate it from acute dilatation. In the latter the initial pain is absent; the patients suffer from epigastric distress; the collapse is gradual and progressive; the most characteristic feature is the abdominal distention beginning in the epigastrium and, in some cases, extending to the pubes. This distention is immediately relieved by the passage of a stomach tube.

In high intestinal obstruction, in my experience, epigastric distention is a very late symptom, and so far in my cases at operation great dilatation of stomach and duodenum has not been found (see Fig. 11).

According to the most recent monograph by *Kayser* of which I have only the review (Centralbl. f. Chir., 1907, xxxiv, p. 242), the mortality among about sixty cases of acute dilatation of the stomach has been 71 per cent.; recovery, with rare exceptions, has followed only the early and repeated use of the stomach tube. Among recent literature Beck (Centralbl. f. Chir., 1907, xxxiv, p. 577) reports the recovery of a girl of fifteen, with symptoms forty-eight hours after appendectomy for appendicular abscess in the pelvis and drainage. These symptoms consisted of epigastric pain and distention. The stomach tube removed a liter of material, although the patient had had no food; in spite of nothing by mouth there was a reaccumulation of two liters in twenty-four hours; the stomach tube was used daily for four days. This observation of Beck demonstrates that there is a second factor in acute dilatation besides gastric atony or paralysis, and that is hypersecretion. In the literature, even in the most recent monograph by Kayser just mentioned, this factor is not dwelt upon with sufficient emphasis.

The observation of *Heile* (Mittheilungen a. d. Grenzgeb. d. Med. u. Chir., 1907, v. Mikulicz Supplement, p. 707) is the best to demonstrate that hypersecretion is a definite factor. It is also of interest in that it illustrates that in chronic dilatation of the stomach with a history of hypersecretion one should be cautious not to select a pyloroplasty or Finney operation, or a Billroth (gastroduodenal end-to-end suture) after pylorec-

tomy, but perform a gastro-jejunostomy with a short loop. In two of the cases reported by me, in which acute dilatation up to the mesentery followed a Finney operation there was evidence of hypersecretion before and after operation in both cases. In my observation of chronic dilatation of stomach and duodenum there was no definite evidence of hypersecretion before, nor after operation. In Heile's case there was a history of pyloric obstruction in a woman of twenty-seven, of eighteen months' duration; vomiting of large quantities of food was the most marked clinical symptom; the contents of the stomach showed an acidity of 60, and free HCl acid; observation before operation demonstrated that the quantity of vomitus far exceeded the intake of food.

The palpable tumor proved to be, at operation, an infiltrating carcinoma in an old ulcer. After resection the duodenum was sutured to the stomach. After operation, in spite of no food by mouth, the patient began to vomit within forty-eight hours and continued to do so for sixteen days. The daily quantity averaged about three liters; it resembled gastric secretion unmixed with duodenal contents; the condition was not relieved by the stomach tube. The patient recovered after a posterior gastroenterostomy. The duodenum was not dilated; there was no mechanical obstruction at the suture; the remaining portion of the stomach which at the operation had been reduced to less than one half, was found, at the second operation, to be as large as the dilated stomach before the first.

This case of Heile, I believe, belongs to a group of acute dilatations in which further experience will demonstrate that after a sufficient trial of the stomach tube and irrigation without relief, operation is indicated: when the dilatation ends at the pylorus—posterior gastro-jejunostomy; when it is a true gastro-mesenteric ileus—gastro-jejunostomy with jejuno-duodenostomy, or the latter alone, should be preferred.

Acute dilatation of the stomach is a lesion which we must be constantly on the alert to recognize, both, as a primary and a postoperative disease. Its recognition should not be difficult. Prompt treatment with the stomach tube and irrigation, re-

peatedly performed, is the first requirement. [In some cases the tube may have to be passed through the nose.] This should be associated with change in position—knee-chest, and left lateral with elevation of pelvis. When the dilatation of the stomach persists and the accumulated fluid fails to pass, and the patient becomes weaker from loss of food, operation should be performed.

The chief etiological factor seems to be some toxic agent in a patient weakened, perhaps, by previous disease and suffering from some chronic gastric lesion. In some cases the toxic factor may be sufficiently great to produce paralysis with hypersecretion in a stomach previously dilatated. This was apparently so in my first case. In the observations during and after typhoid, in pneumonia and scarlet fever, the patient is first weakened by the disease; then, later, the acute dilatation has its onset. It seems strange that acute dilatation of the stomach has only recently been observed in eclampsia (Audebert et Fournier: Comptes Rendus de la Soc. d'Obst., de Gynec. et de Paed., 1907, vol. ix, p. 116). My attention was called to this article by my colleague, Dr. Williams. In the first reported case, there were two factors—the toxins of eclampsia and the chloroform used at the delivery; the condition was recognized and properly treated with the stomach tube, and although the patient was critically ill, she recovered. In the second case, there was a third factor—a general streptococcus septicæmia from a uterine infection; in spite of early recognition and treatment, the patient died within eighteen hours after the first symptom; there was huge dilatation of the stomach, and, in addition, great dilatation of the cecum, ascending and transverse colon; there is no note on the duodenum. In my Case 2 (Fig. 4) the cecum was dilated, and I found an adhesion kinking the ascending colon just above the cecum, not shown in the illustration. In this reported case, there was an adhesion kinking the transverse colon.

In regard to postoperative acute dilatation of the stomach, surgeons should give more care to the preparation of the patient before operation, especially in laparotomy cases. For at least

forty-eight hours food should be very much restricted; cathartics should not be used just before operation; when the operation is for a lesion situated some distance from the stomach considerable attention should be given to this organ in the history and examination. I have already used Heile's case as an observation of the importance of properly selecting the operation for relief of gastric dilatation with hypersecretion associated with stenosis or tumor. When this dilatation follows operations upon the gall-bladder or the ducts, or any operation in which drainage has been introduced in the region of the duodenum, the drains should be loosened or removed immediately if there are any symptoms of acute dilatation. I now remember that Dr. Halsted had such a case in which the symptoms began with persistent vomiting of large quantities of gastric material twenty-four hours after cholecystectomy and drainage. I have had one such observation, in which the symptoms were of a lighter degree. Both recovered after loosening of the drain and the stomach tube.

Orthopedic surgeons must bear in mind the possibility of acute dilatation in their cases of kyphosis. These patients should be cautioned against over-eating, especially after a plaster jacket is applied. NECK (Zentralbl. f. Chir., 1907, xxxiv, p. 58) in his most recent contribution since his collective review on this subject, reports four primary cases, with three recoveries after the use of the stomach tube; in two the patients were kyphotic and gave a history of over-indulgence in food; in one patient there was a history of only an excess of food and liquid; in the fourth an overdose of *veronal* seemed to be an etiological factor. All cases had the characteristic symptoms and physical signs.

In an extensive clinical and experimental study recently brought out by BRAUN AND SEIDEL (Mittheilungen a. d. Grenzgeb. d. Med. u. Ch., 1907, xvii, p. 533) and the monograph of Kayser (loco. cit.) there is nothing especially new. All the etiological factors are by no means established. These two most recent communications advocate the view that the dilatation is primary in the stomach; that duodenal dilatation,

if present, is secondary, and this is brought about by a kinking at the mesentery. The latter is due to pressure of the stomach on the mesenteric vessels and traction of the mesentery of the small intestine. The primary acute dilatation of the stomach is brought about by the action of some toxins on its nervous mechanism.

In the observations of my own cases and now, after a careful reading of the literature extending over a period of three years, I am not at all convinced that we have settled either the etiology, or the pathological anatomy of this affection. To me the more interesting group are those cases in which the dilatation extends to the mesentery and in which there is no evidence of a pathologic condition to explain the obstruction other than the normal anatomical factors at the mesenteric junction of the duodenum and jejunum.

I was also impressed by the fact that in two of my observations relief of tension on the mesentery and jejunum, pressure on the duodenum, and pushing up of the dilated stomach did not relieve the obstruction nor allow the duodenal contents to flow into the jejunum. In my first case the presence of stomach peristalsis three and a half days after the onset of the symptoms is evidence against complete paralysis, and I wish to emphasize again the importance of hypersecretion.

In conclusion I again call especial attention to Case 3, which is undoubtedly an example of chronic gastro-duodenal dilatation or gastro-mesenteric ileus. Further experience may demonstrate that this is the common pathological condition of many cases of gastric neuroses, which have not been relieved by posterior gastroenterostomy, and which may be relieved by duodeno-jejunostomy.

I find that I have failed to mention the very comprehensive review of Lewis A. Conner, of New York (Amer. Jour. of the Med. Sciences, March, 1907, vol. cxxxiii, p. 345), who reports an observation of his own and makes a critical analysis of 102 cases recorded in the literature. In this series there was no example of the complication following operations on the stomach itself. Two are recorded among my observations,—Finney's pyloroplasty, and one from the literature. Stomach peristalsis as observed in my first case, according to Conner, has been noted in only three of the 102 observations. Conner's bibliography is complete up to date.

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# TUBERCULOSIS OF THE CÆCUM,

WITH A REPORT OF TWO CASES.

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FROM the pathologic view point tuberculosis of the cæcum may be divided into three forms as follows: (1) the ulcerating form; (2) the entero-peritoneal form, and (3) the hypertrophic form.

The ulcerating form represents the ordinary intestinal tuberculosis and, like all parts of the intestine, the cæcum may present ulcerations of a tuberculous nature. When arising from an intestinal tuberculosis, the ulcerations become localized more particularly in the terminal portion of the ileum, where they may remain without extending beyond the ileocæcal valve; but they may also invade the mucosa of the cæcum. In the large majority of cases tuberculous ulcerations are secondary and they undergo their evolution in patients presenting pulmonary lesions. They may occasionally be primary, but, under these circumstances, they are much more localized and, in one case reported by Jaboulay, the lesion was localized on the posterior aspect of the cæcum. The ulcerations appear more commonly in the closed follicles and Peyer's patches. In shape they may be either oval or circular, while their long axis is perpendicular with the axis of the intestine. Less frequently tuberculous ulcerations primarily arise in the cæcum and from there extend to the ileum, but however this may be, whether the localization is primary or secondary in the cæcum, these ulcerations never form stenoses sufficiently narrow to prevent the feces from passing. Fibrous tuberculosis giving rise to stenosis is frequently encountered in the small intestine, but is probably never met with in the large intestine, and the cæcum in particular.

Although it has been upheld that cicatrical tissue arising from tuberculosis and producing stenosis may possibly occur in

the cæcum we can hardly admit such a conclusion, because, in point of fact, the small gut is not comparable to the large intestine and what may happen in the former cannot occur in the latter. The calibre of the large intestine is notably greater than that of the small, so that cicatricial bands and annular stenoses which may, in the small intestine, arrest the progress of the feces cannot arise in the large intestine unless in the form of incomplete diaphragms incapable at any rate of being a serious obstacle to the onward passage of the feces.

The entero-peritoneal form of intestinal tuberculosis is represented by a complete involvement of the cæcum, the terminal portion of the ileum, with involvement of the mesentery and its lymphatic glands. The ulcerations of the mucosa extend in depth, burrowing through the intestinal layers and opening in the peritoneum, which structure itself is also involved in the process. Riddled with tuberculous granulations, it is covered with lymphnodes undergoing degeneration and the formation of multiple abscesses, while numerous strong adhesions are formed between the gut and the neighboring viscera. They frequently unite the cæcum to the posterior wall and the ureter and blood vessels are included in this tuberculous mass, so that, if an attempt is made to resect the neoplasm, there is considerable likelihood of injuring these organs, so that in one instance, Czerny wounded the ureter and was obliged to do a nephrectomy. The abscesses scattered throughout the large tumor formed by the intestine and the mesentery have a tendency to increase in size; they project and burrow towards the exterior and where this is going on the integuments become red and thin, so that finally the purulent pocket opens outwards by way of a more or less tortuous and fungous fistula. As has been pointed out the intestine itself communicates with the abscess from the progress of the ulcerated process so that a solution of continuity between the lumen of the gut and the skin takes place and a fecal fistula is thus created.

These fistulæ usually open either in the anterior abdominal wall, at the umbilicus, the cæcal region, or, which is more fre-

quent, in the right iliac fossa, even in those cases where the cæcal region is invaded. Occasionally they may open into the intestine (colon or small intestine), thus creating spontaneous entero-anastomoses. Then, again, the orifice of the fistulæ may be at some distance from the lesion, such as in the lumbar region. And lastly, the suppurative process may become directed towards the pelvis, project into the vagina and thus simulate a pelvic collection.

The hypertrophic form of intestinal tuberculosis may truly be called the surgical type and, for this reason, more detail will here be given. Hypertrophic tuberculosis of the cæcum is usually primary, I might say always, if one were permitted an absolute affirmation in medicine. Primary tuberculoses are at the present time thoroughly demonstrated to exist, particularly for the bones and joints and the intestine may also be primarily attacked, the cæcum in particular. There is probably not a single operator who does not recall tuberculous lesions of the cæcum undergoing their evolution independently of any pulmonary lesion, with the general condition of the patient frequently intact, or only somewhat weakened from the fact of the intestinal lesion, which does not even appear to reach the peritoneum. After a radical, or merely a palliative operation, every trace of the process disappears and these patients become well without any pulmonary manifestations occurring, just as is the case of tuberculosis of the skeleton.

Hypertrophic tuberculosis of the cæcum is primary, and it may perhaps be said that, if in a patient tuberculous lesions of the lung are encountered at the same time as those of the cæcum, the *latter being of the hypertrophic form,* the lung involvement is the result and not the cause of the process in the intestine. In a case recorded by Caussade and Charrier, the patient presented in the beginning gastro-intestinal symptoms with a tumor in the right iliac fossa, without any stethoscopic evidence, but two years later he had beside the intestinal disturbances, pulmonary lesions. Consequently, in this case the cæcum was the primary point of infection. Clinically speaking, when a pulmonary phthisis gives rise to localizations in

the intestine, the result is an ulcerating process and not hypertrophic tuberculosis.

It is a fact that hypertrophic tuberculosis is rarely in the small intestine, its points of election being the cæcum, the angles of the colon and, lastly, the rectum.

Tuberculosis of the cæcum begins in the neighborhood of the ileo-cæcal valve. It was thought formerly that the terminal portion of the ileum was involved at the same time as the cæcum or before the latter, but, at the present time, this is no longer admitted. In the large majority of cases, hypertrophic tuberculosis commences in the cæcum, remains there and has no tendency to invade the ileum, and, although formerly many cases were published where the ileum was involved, it was because that, although the hypertrophic tuberculosis in the commencement remained limited to the cæcum, it in the course of time acquired a greater malignancy, so that to the hypertrophy of the walls of the gut ulcerations of the mucosa became added, and then only, the tuberculous process involved the ileo-cæcal valve and became propagated to the terminal portion of the ileum. Consequently, it is not the hypertrophic tuberculosis which becomes generalized to the ileum, but one is in reality dealing with a secondary tuberculous ulcerative process.

In many cases the mucosa of the hypertrophied cæcum has been found healthy, without ulcerations, while the ileum in no way participated in the process, its walls having retained their normal thickness. In other instances more or less extensive ulcerations in the cæcum have been noted, but the ileum has not as yet become invaded. And lastly, in other cases the ileum participated in the process and the mucosa of both the cæcum and ileum has been found covered with numerous, and occasionally very extensive, ulcerations.

Now, although the extension of the disease does not generally tend towards the ileum, the same cannot be said in the other sense, because hypertrophic tuberculosis may invade the ascending and the transverse colon and even extend still further. In one of Dieulafoy's cases the thickening extended to the hepatic flexure, while in a case recorded by Roux, he

was obliged to remove the cæcum, ascending colon and a portion of the transverse colon. In an autopsy reported by Pilliet and Hartmann, in a case of Bezançon and Lapointe, the entire large intestine, as far as the sigmoid flexure was involved in the hypertrophic process. To sum up, it may be said that hypertrophic tuberculosis of the cæcum takes a descending course, that is to say, towards the colon.

In some instances the neoplasm only occupies a portion of the cæcum. Two such cases have been recorded by Richelot, in one the tumor being situated on the posterior aspect of the cæcum and having the dimensions of a fifty cent piece, while in the second case it occupied the ileo-cæcal angle. Cases of this kind are rather the exception and massive hypertrophy of the cæcum is the rule. The tumor presents a bossed aspect, recalling that of carcinoma; it is hard and in size may vary from a tangerine orange to two fists. Far from producing tuberculous ulcerations of the gut or a thinning of its walls, as in other varieties of intestinal tuberculous ulcerations, this particular form is characterized by a marked thickening of the various layers and the formation of a sclerotic lipomatous mass around the cæcum, which is very resisting to the feel and easily brings to one's mind the idea of a malignant neoplasm.

This sclerotic lipomatous mass is exactly similar to that surrounding tuberculous kidneys or bladders and is the result of a defensive process for the limitation of the infection. It forms an integral part of the tumor and is even with difficulty separated from it, especially in certain portions and more particularly in the neighborhood of the ileo-cæcal valve, at which point there is a complete union between the intestinal layers and the pericæcal lipomatous atmosphere. In the midst of this sclerotic lipomatous tissue will be found the hypertrophied cæcum. The hypertrophy is never the same at all parts and may even vary very greatly. All the layers of the cæcum are involved in the hypertrophic process, but most unequally and Dieulafoy has rightly said that: "all the layers are thickened, but the hypertrophy is more particularly marked in the subperitoneal cellulo-fibrous and in the submucous layers." For

convenience sake, and with all due correctness, it may be said that the submucous and subserous layers form more than four-fifths of the neoplasm.

As a consequence of the hypertrophy of the walls of the gut a stricture in the lumen of the cæcum may result. The calibre of this organ may be considerably diminished, the ileo-cæcal valve almost completely occluded, but in every case one is dealing with a neoplastic stenosis and not one of the cicatricial type. Occasionally one has observed an ampullar dilatation of the cæcum instead of a stricture of its lumen, which has caused Dieulafoy to say that there exists a concentric hypertrophy with stricture and an eccentric hypertrophy with dilatation of the cæcum.

Microscopically much of interest is to be found. The mucosa participates in the hypertrophy. No ulcerations may be present and this is particularly the case in the early part of the process. Later on, the submucous cheesy tubercles may open at the surface, destroying the mucosa in certain areas and thus give rise to ulcerations which, occasionally, may occupy the larger portion of the cavity of the cæcum. Beside these ulcerations verrucose or polypous projections will be found on the mucosa and opaque white points which are very distinct and represent the caseous foci developed in the dermis of the mucosa. These points may, of course, be wanting.

The submucous layer is the structure where the primary localization of hypertrophic tuberculosis takes place. The disease begins in the lymphoid organs, the follicles and Peyer's patches, because tuberculosis of the cæcum is above all *a lymphatic tuberculosis.* The thickened submucous layer microscopically shows an unequal portion of inflammatory and tuberculous elements. It is in the midst of a collection of small round embryonal cells, generally mononuclear and with a small amount of protoplasm, in other words, inflammatory cells, which, not infrequently, give rise to mistaken diagnosis of lympho-sarcoma, where are to be found the tuberculous follicles scattered here and there. The latter are in more or less

numbers, having either a tendency towards sclerosis or caseation, according to the evolution of the affection.

The muscular layer participates but little in the hypertrophy; it is infiltrated and its muscular fibres are dissociated by masses of inflammatory cells, but they are not increased in number.

The subserous layer is greatly hypertrophied and here again one meets with a very unequal mixture of tuberculous and inflammatory elements. The tuberculous follicles are generally larger than those met with in the neighborhood of the lymphatic organs. As in the submucosa, these follicles may take on a sclerous or caseous evolution according to the type of the affection, but, as in its commencement, hypertrophic tuberculosis is benign with a slow progression, a sclerous evolution is the more frequent.

To sum up one may define hypertrophic tuberculosis of the cæcum as: the result of a battle between the inflammatory and tuberculous elements and taking place in the structures of the cæcum particularly rich in lymphoid tissue.

The result of this battle is that in the commencement, and for a long time, the tuberculous lesions are few in number, and it may even happen that they completely disappear, in which case the inflammatory elements have conquered and choked the nascent tuberculosis so that microscopically nothing is seen in the tumor but inflammatory cells without any trace of tuberculous elements.

Hypertrophic tuberculosis does not merely remain localized in the walls of the intestine, because it involves the neighboring lymphnodes, particularly those of the ileo-cæcal angle. Occasionally this lymphatic tuberculosis may extend for some distance from the primary lesion and it has been known to reach the neighborhood of the diaphragm, or extend along the aorta up to the pancreas.

In the majority of cases the ileo-cæcal valve will be found hidden in a cicatricial mass, it being retracted, indurated, thickened and superficially involved in an ulcerative process with polypoid vegetations here and there. Its indurated orifice may

be considerably narrowed, while in other cases the orifice of the valve may be obstructed by the tuberculous neoplasm, this occurring in one of my cases, which may be summed up briefly as follows:

The examination of the cæcum after resection showed that in its interior there was an irregular tumor planted on the upper aspect of the ileocæcal valve, it having a cauliflower structure and its size being that of a small apple. It obstructed the lumen of the valve completely and macroscopically closely resembled a carcinoma. The terminal portion of the ileum was dilated and somewhat thickened by a submucous infiltration. For about five centimetres beyond the cæcum the colon was also thickened, although no lesion of its mucosa was observed. The peritoneum and appendix appeared healthy and there were only three small lymphatic glands in the mesentery. Microscopical examination of the cæcum with a high power showed that the process was tuberculous. The patient, a female, 87 years of age, was seen in consultation with Dr. Dalton, formerly of Cambridge, who gave me the following history. She had complained of pain in the right iliac region for about eighteen months. This was a painful sensation with periods of increase usually occurring a few hours after eating and by and by this became so marked that the patient restricted her diet. The stools were infrequent, requiring purgatives and the patient was rapidly losing flesh.

I saw the patient during an attack of colicky pain, so that we were obliged to resort to examination under an anæsthetic. The abdomen was not greatly distended and by bi-manual palpation nothing pathologic was found in either the uterus or its adnexa. However, at about the situation of McBurney's point, or a little higher, a hard, rounded tumor could be felt, which was fairly movable transversely. To the hand it felt about the size of a large orange and did not appear to be adherent either to the deeper structures, or to the abdominal wall. The other abdominal organs, as well as the thoracic viscera gave no evidence of any pathologic process. There was little or no elevation of temperature in the evening and the pulse, of good quality, was 88.

Given the patient's general condition and the history of the case, I was inclined to believe that one was dealing with a carcinoma of the cæcum and operation was advised. An incision in

the right semi-lunar line was made and exposed a greatly enlarged and indurated cæcum covered by an apparently intact peritoneum. On account of the extreme mobility of the neoplasm resection of the cæcum was undertaken, 8 centimetres of the ileum and 6 of the ascending colon being removed along with the cæcum. The ends of the large and small intestine were then closed by a through and through hemostatic suture of linen thread, this being buried by a superficial row of continuous Lembert's suture with fine chromic gut. After this, lateral anastomosis of the ileum with the ascending colon was easily accomplished. The patient made an uneventful recovery, having a natural motion two days after the operation and left the hospital on the 20th day in excellent condition. She was seen nineteen months after the operation, for the last time, when she was found to have considerably gained in weight and was in apparent good health.

As to the condition of the appendix found in tuberculosis of the cæcum it may be said that, as in the case of the ileum, it does not in the beginning participate in the process, but later on when the lesion has become extensive and ulceration has been added to the hypertrophic mass the appendix may in its turn become involved and form an integral part of the neoplasm. In certain cases it may be completely lost to view being imbedded in the sclerous pericæcal mass.

Referring now to the symptomatology it may be said that tuberculosis of the cæcum commences slowly, sometimes arising in an otherwise perfectly healthy patient, or on the contrary in one already predisposed by some local or general affection, such as gastro-enteritis, typhoid fever, dysentery, etc. It makes itself manifest in the first place by abdominal pain and intestinal disturbances. The latter consist in alternating diarrhœa and constipation, while the abdominal pain appears in the form of violent colics, localized in the region of the cæcum. The attacks of colic may be of very short duration, rarely extending over twenty-four hours, after which they subside, leaving some sensitiveness in the abdomen, which is particularly evident in the right iliac fossa.

Constipation may be the only symptom when the affection

results in a stricture of the ileo-cæcal valve, or by obstruction of the latter by the tumor, as in the case above reported. Occasionally, the disease may commence suddenly with phenomena of circumscribed peritonitis.

After a few months, or a year or two, according to the rapidity of the evolution of the process, the lesions oblige the patient to seek surgical relief. If a suppurating perityphlitis has supervened one or several fistulæ will be found in the region of the right groin. The pus may also burrow down towards the small pelvis and reach the ischio-rectal fossa and make its exit at the side of the anus.

By palpation a tumor in the right iliac fossa will usually be discovered. A hard, resisting mass, with an unequal surface, and having a cylindrical form, will be made out, although, in many reported cases, including my own, the growth was distinctly oval in shape. In size the neoplasm will vary from that of a walnut to an orange, or even more and if not adherent to the abdominal wall, the latter will remain smooth to the feel, while the growth will slide over the deep structures. When the tumor is adherent to the viscera contained in the iliac fossa its mobility will be more evident in a transversal direction. If there is only a tumefaction, simply giving the sensation of an indurated abdominal plaque, one would be more likely to suspect an aggravated form of appendicitis and here the diagnosis is frequently extremely difficult.

On percussion the neoplasm will usually present an area of dullness in its centre. If fistulous tracts are present, they should be prudently explored in order to ascertain their length and direction. The lymphnodes of the right inguinal region are sometimes enlarged and it is usually impossible to distinguish them apart from the tumor, or the mass formed by the enlarged glands of the iliac fossa which constitute an indurated mass which is lost in the depth of the lumbar region. One should carefully search for other localizations of tuberculosis, because these patients may already have slight lesions in the lungs or other viscera.

The functional symptoms are merely an exaggerated form

of those met with in the commencement of the disease; the pain becomes more persistent and the digestive disturbances more marked. If the process takes on an obstructive type with a rapid evolution the periods of constipation may be extremely prolonged and may last a week or more. The patient suffers in the right iliac fossa a few hours after eating, a symptom also very pathognomonic of carcinoma of the cæcum, as I pointed out several years ago in my paper on this affection, written in collaboration with Dr. Vander Veer.[1] One also meets with attacks of vomiting, the matter voided occasionally having a peculiar odor, although never fecaloid. This is due to the stagnation of the food in a dilated stomach, a condition not infrequently observed in patients afflicted with chronic affections of the cæcum. Indican may be present in the urine, as in all cases where fermentation is occurring in the intestine.

The general condition may remain very satisfactory for a considerable length of time, but finally loss of appetite and strength occur and the patient takes on a waxy look. There may or may not be a rise in temperature, but when this does occur it is apt to indicate a focus of tuberculosis in the lungs.

The hypertrophic type of tuberculosis of the cæcum affects the clinical aspects of a malignant neoplasm and, as I have already pointed out, it resembles closely carcinoma. The principal characters of this form are the development of a tumor in the right iliac fossa, whose increase in growth, ordinarily slow, but occasionally quite rapid, is accompanied by pain in the form of short, but very violent attacks of colic. It may also be characterized by evidences of intestinal occlusion, accompanied by vomiting, which, although of an alimentary nature may, as we have pointed out, have a peculiarly fetid odor. Complete intestinal occlusion has been met with, although very infrequently.

The ulcerating form simulates pure and simple inflammation of the cæcum and its appendix and usually no tumor is present, but a diffuse infiltration or a simple tumefaction may be made out. When the lesions extend to the appendix a small

[1] ANNALS OF SURGERY, January, 1902.

tumor may be discovered. The abdomen is distended while constipation and vomiting are not infrequent. In the more advanced phase chills and fever appear, indicating the formation of pus in the iliac fossa.

After a period of chronicity, interspersed with acute phenomena, which varies from months to years, the development of the lesions may cease by an appropriate medical treatment or else the symptoms may increase in intensity, the general nutrition becoming less and less, so that the patient dies from inanition as in any other tumor obstructing the intestine. Death may result from tuberculous peritonitis, while if the lungs become involved the patient dies from tuberculous cachexia.

Other serious complications bringing about a fatal outcome, such as perforation from ulceration of the intestines, or a fecal abscess arising in the cellular tissue of the iliac fossa are to be feared. If the affection evolutes towards a cure, a very serious stenosis may result like any following an ulcerating intestinal lesion from the resulting cicatrix. A right-sided pleurisy is frequently an excellent diagnostic indication, and I would also mention an instance of hydronephrosis resulting from compression of the ureter by the cæcal neoplasm.

In making a differential diagnosis one of three conditions may be present, namely, (1) there is a tumor; (2) there is no tumor, but a diffuse infiltration of the right iliac fossa is detected; (3) one or several fistulæ are present in the right iliac fossa.

If the tumor is due to an accumulation of feces the galvanic current and purgation will settle the question, but, if after these means, the tumor is still felt, carcinoma of the cæcum is what usually first comes to one's mind. In both tuberculosis and carcinoma of the cæcum, especially when the former lesion is somewhat advanced, the patients present a waxy look, there is loss of flesh, while the shape of the growth, being oftentimes cylindrical and elongated in a vertical direction, adds greatly to the obscurity of the diagnosis, but what is still more perplexing is the prolonged constipation, an indication of chronic intestinal obstruction, involvement of the lymphatics

in the right groin and absence of a rise in temperature, and frequently, when the growth is examined after removal there is difficulty in coming to a correct differential diagnosis between tuberculosis and carcinoma.

As differential signs it may be mentioned that the hypertrophy is far more rapid in a case of carcinoma, likewise the secondary involvement of the mesenteric glands, while in tuberculosis the surface of the neoplasm is less bossed. Of course, these differences are in reality of very slight importance. At a more advanced phase the tumor softens, the skin becomes red and thin and adheres to the underlying structures. When the period of suppuration is reached, when by one or several fistulæ pus is given exit, the bacteriological examination of the latter, with animal inoculation, allows one to come to a correct diagnosis, but which at this advanced stage of the process is of little use.

To sum up it may be said that the long duration of the disease, the greater frequency of spontaneous or provoked pain, the relatively young age of the patients, the presence of Koch's bacilli in the stools, will greatly aid in making the diagnosis of tuberculosis of the cæcum. On the other hand, intestinal lymphadenoma, chronic adenitis of the iliac glands, movable kidney and actynomycosis are more easy of differentiation. In the female, the diagnosis is rendered difficult between appendicitis or suppurating lesions of the adnexa, but from this short consideration of the symptomatology, is to be particularly pointed out the great difficulty of differential diagnosis between carcinoma and tuberculosis of the cæcum, and secondly, the occasional impossibility to precisely determine whether one is dealing with a tuberculosis of the cæcum involving the appendix or a simple chronic relapsing appendicitis.

When the tuberculous process is distinctly limited to a portion of the cæcum, a partial resection of the organ may be undertaken, upon the condition that the intestinal calibre will not suffer from removal of a portion of the organ. If the resection, to be of any curative value, must be extensive, so that a stricture of the gut might be the consequence, complete

removal of the ileo-cæcal segment should be undertaken. When the process has involved the precæcal glands, they should be removed, or if their extirpation is rendered impossible on account of extensive adhesions with the intestinal wall, they should be incised and curetted.

A tuberculosis of the ileo-cæcal region without tumor formation and giving rise to fistulæ requires the same treatment as tuberculosis with a neoplastic formation, viz., bilateral exclusion of the diseased segment. If a general peritonitis from perforation is present, laparatomy and search for the perforation may be attempted, but this is usually a very difficult undertaking.

As far as the results of exclusion of the intestine are concerned, it may be said that they are usually quite satisfactory. This interference has been resorted to in cases of cæcal tuberculosis without fistulæ. In Ulmann's case, after bilateral exclusion with an iliac anus from the colon, there was a considerable decrease in size of the growth, while in Frank's case, in which bilateral exclusion with suture of both the small and large gut to the skin, the tumor had entirely disappeared seven years after the operation. There was only a slight prolapsus of the mucosa of the colon with a trifling amount of mucous discharge, the opening of the ileum having become almost closed. In a case reported by Ewald and seen three years later, the opening into the small gut had entirely closed, while that of the colon presented a prolapse of the mucous membrane to a slight degree and only gave issue to a serous fluid requiring a new dressing once a fortnight. In other instances intestinal exclusion has, later on, allowed one to resect the diseased structures, which, at the time of the first interference, was considered impossible.

When fistulæ are present the ultimate results of exclusion have also been satisfactory. In Wiesinger's case, the result was a fistula which excreted a very small quantity of pus, while the neoplastic mass had decreased in size and there was a great improvement in the general condition of the patient. Albert's patient was seen three months after the operation, at which

time the pre-existing fistula was found to have closed; the growth was much smaller, and, since the operation the patient had increased ten pounds. A young boy operated on by Gnesea made weight rapidly after the operation, while the tumor diminished in size and became movable. In Friedländer's case the patient increased 14 lbs. in six weeks, while Ricard's patient increased 36 lbs. in three months after the operation, the growth was diminishing and the fistula only gave issue to a small amount of serous fluid. These few instances are sufficient to show the benefit which may be derived by exclusion of the ileo-cæcal segment, while the operative mortality is small, since, out of 30 cases, there were only two deaths directly due to the interference. However, it may be said that resection of the cæcum is decidedly indicated in tuberculosis of the cæcum when the latter represents the hypertrophic type and as soon as a diagnosis is made surgical interference is at once demanded. Resection is absolutely indicated when there is a tumor without abscess formation or fistula and, under these circumstances, it is a radical operation, because it removes the focus of tuberculosis from the body. If resection is found difficult or dangerous on account of extensive adhesions intestinal exclusion is then to be preferred.

Resection of the ileo-cæcal segment was easily carried out in my second case, the patient being a woman 27 years of age and married for five years, who was referred to me with a diagnosis of movable right kidney. She had had one child two years previously, the labor having been perfectly normal. For the past eight months the patient had suffered from dyspeptic phenomena and frequent attacks of colicky pain. There was alternating constipation and diarrhœa. For the past two months there was a dull and constant pain in the right iliac fossa. Three weeks before coming under my observation the patient developed what appeared to be an inflammatory attack in the region of the cæcum accompanied by a rise in temperature, tumefaction and constipation. The attending physician at this time diagnosed the case as one of appendicitis, but, as she rapidly recovered from the attack, and as afterwards he could distinctly make out a fairly movable

tumor about the size of the kidney in the iliac fossa, he revised his diagnosis and considered it to be a movable kidney, which had become adherent in that region.

The patient was pale and thin with the abdomen slightly distended. The constipation was still persistent, requiring an enema daily and from time to time she suffered from slight colic in the lower abdomen. A tumor the size of a mandarin orange could be felt distinctly in the right iliac fossa; it was movable, particularly transversely and slightly tender on pressure. Percussion did not reveal any dullness over its surface. A careful examination of the thoracic and abdominal viscera proved negative. The urine was normal.

Given the history of the case I was rather in favor of a diagnosis of tuberculosis of the cæcum, because, although the patient was quite thin, she did not present that characteristic aspect of cachexia, so often present in malignant disease of the gut. An operation was, therefore, advised.

An incision in the semi-lunar line exposed the peritoneal cavity and a few soft adhesions uniting the cæcum to the parietal peritoneum. These were broken down with ease and the cæcum was found fairly movable, so that it could be drawn out of the abdominal wound. It was greatly enlarged, the peritoneal surface somewhat injected, and by palpation its walls were found greatly thickened and at one point near the ileo-cæcal valve a tumor could be detected. Resection of the cæcum with three centimetres of the ileum and three of the colon was quickly accomplished and end to end anastomosis with linen thread was easily done. A small cigarette drain was inserted and abdominal walls closed by three layers of sutures. Recovery was uneventful, the patient having a spontaneous motion on the third day after the operation and she was able to return to her home in seventeen days. The drain was removed on the second day and the small opening left in the abdominal wall after its removal closed in a few days.

Examination of the cæcum after removal showed that all its walls were thickened and that in the region of the ileo-cæcal valve this thickening had attained the thickness of seven centimetres and which during the operation on palpation of the organ had given the impression of a neoplasm. A careful examination of the abdominal cavity did not reveal any enlarged lymphnodes

in the mesentery or elsewhere. Microscopical examination of the cæcum showed numerous giant cells in its walls and points of caseation, so that the anatomical diagnosis was tuberculosis of the cæcum.

If a patient should present a limited focus of tuberculosis in one lung I believe that this is not the contra-indication for radical interference on the cæcal lesion, because the latter is a serious hindrance to forced feeding and when the process is removed, there will probably be a return to the normal in the digestive functions, which can only have as a result a happy influence on the general condition, thus indirectly improving the lung lesion. Acute postoperative pulmonary lesions are infrequent, but, if an extensive pulmonary infiltration is present, accompanied by an evening rise in temperature, night sweats and a rapid loss of flesh, any operation on the intestine is contraindicated. This also applies when frequent and tenacious diarrhœa is present (indicating a diffusion of the lesions in the intestinal mucosa, while a marked albuminuria, indicating a tuberculous nephritis is also a contra-indication.

# STRANGULATION RESULTING FROM DISTENTION OF HOLLOW VISCERA.

## ITS BEARING UPON APPENDICITIS, STRANGULATED HERNIA AND GALL-BLADDER DISEASE.

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SEVERAL times during the past four years I have made the assertion that distention of the appendix back of an obstruction in any part of its lumen would interfere with its circulation even to the point of arresting it entirely.

The following experiments upon dogs were undertaken to demonstrate this fact.

The placing of an electric light bulb in the lumen of the appendix or the intestine made it possible to directly observe the circulation under the microscope and opened up a wonderfully interesting and inviting field for study.

After proper etherization a loop of intestine was withdrawn through an abdominal incision, a canula tied into one end of it and a small electric lamp into the other. The whole was then brought under the microscope and the circulation in the wall of the gut studied under different pressures by water introduced through the canula. The degree of pressure was noted on a mercury manometer, placed in circuit with the pressure bulb. The same experiment was done on the appendix and the same results obtained.

The following are the principal observations as they relate to this study.

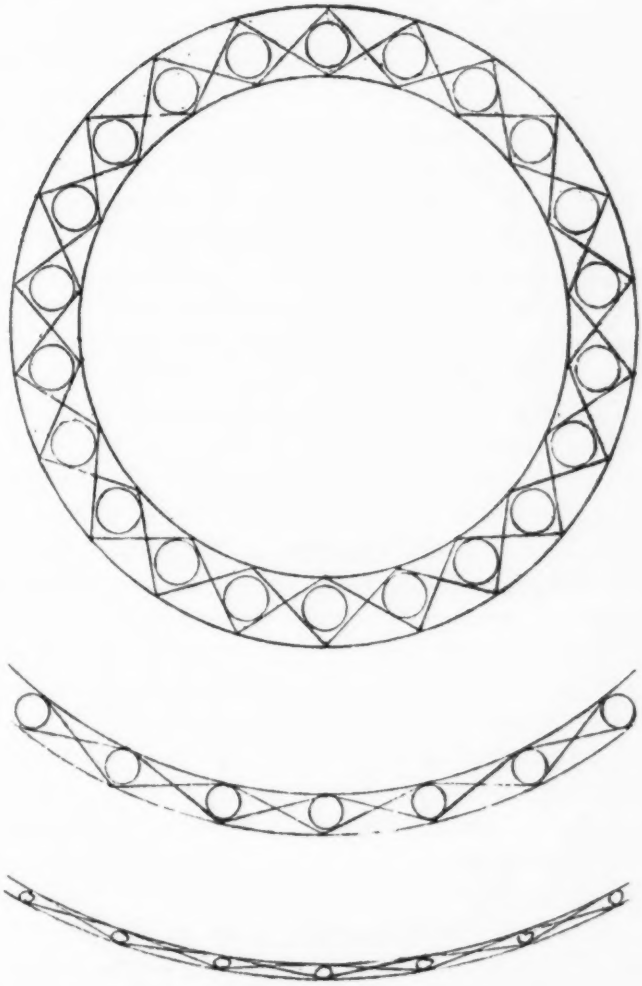
At 30 millimeters mercury pressure we found that some capillary streams were arrested.

At 60 mm. many small veins had their currents arrested, and in most of them the stream was so slow that individual corpuscles could be seen.

At 90 mm. a most interesting study presented itself. All blood streams were moving slowly and many were not moving at all. One was impressed with the difficulties encountered by the circulation in its attempt to find some point of least resistance through which the stream might insinuate

itself. Currents would at one time go in one direction and the next moment in the opposite. At the point of branching of vessels, streams were seen going in all sorts of directions.

FIG. 1.



Schematic representation of constriction of the blood-vessels in the walls of a distended intestine or appendix. (*a*) Normal. (*b*) Moderately distended. (*c*) Fully distended. The tense tissues in the thinning wall blot out the space for blood-vessels.

At 130 mm. all circulation had ceased—the corpuscles standing still in the blood vessels. Many vessels, however, still carried the impulse of the heart beat—the corpuscles moving to and fro, but retaining their relative

positions in the field. This pulsation was seen in some of the largest and the most superficial arteries after the pressure was carried up to 250 mm. (Fig. 1).

Some ecchymotic hæmorrhages were noted as early as 50 mm.

Gut kept at 80 to 90 mm. pressure for an hour was enormously "congested;" that is, the apparent number of veins seen on the serous surface was greatly increased and their caliber was also greatly increased.

Evidently there was great damming back against the aggressive high pressure in the arteries and, in its effort to find exit into the open veins beyond, the stream had been forced into many unfrequented paths.

Pulsation in the veins was noted frequently at the comparatively lower pressures and constantly at high pressures, illustrating the fact that capillary and venous pressures are relative—being the result of the arterial impulse as resisted by the obstruction to the venous return. The more firmly the column of blood is held the more directly and positively the impulse is carried.

That effusion accompanies such obstruction and congestion is so obvious from daily clinical observation that I shall not stop to discuss it here. Enough to say that drops of fluid were observed standing upon the surface of the gut like beads of perspiration. When we remember how quickly exposed peritoneal surfaces become dry and note that the exposure in this case was open to the dry air of Southern California the evidence of effusion becomes still more conclusive.

The demonstration seems complete that distention of gut (or of other hollow viscera) interferes with the circulation in its walls, and allows infiltration and effusion to take place into its walls and lumen and any other open space which may come within its influence.

The return circulation is retarded at comparatively slight pressures. Effusion follows, as in all obstructions to venous flow. As the average venous pressures in the intestines under ordinary circumstances probably varies from 4 to 10 mm. mercury, any pressure beyond that will offer some resistance to the return current. Tiegerstedt (Text-book on Physiology) gives pressures in a number of veins corroborating these

figures. This effusion into the tissues of the walls and into the lumen of the gut increases the distention. When the distention reaches the point where it produces a pressure in the intestine equal to that in the arteries, circulation is entirely arrested.

This mechanical interference with the circulation explains a number of surgical conditions.

In the early pathology of acute appendicitis it is responsible for most of the initial changes.

In connection with the roll of the ball valve in the etiology of appendicitis, I have discussed it in So. Cal. Practitioner, Sept., 1903, Jour. Am. Med. Association, March 26, 1904, and in the ANNALS OF SURGERY, March, 1905.

Acute appendicitis always finds a constricted or kinked appendix. Fecal matter, whether in the form of a concretion or not, lodges behind this constriction, forming a ball valve. Secretion behind the obstruction soon produces some distention, and pressure upon the circulation. This means effusion and more pressure and the vicious circle is established. Effusion and pressure mean infection as soon as resistance is sufficiently lowered by interference with the blood supply, and the minute traumatisms and ecchymotic hemorrhages have made the entrance of germs sufficiently easy.

If the plug is fortunately driven out early through the constriction by the rising pressure the ensuing inflammation may be very slight. But if it remains the lumen of the appendix beond the constriction becomes a veritable abscess cavity and pressure continuing to rise, necrosis or gangrene of the wall is certain to follow.

In strangulated hernia it is a very important consideration. The first step in the process is just enough obstruction at the ring to prevent the easy return of the hernial mass which has been crowded into the sac with perhaps more than its accustomed abdominal pressure. This obstruction is sufficient to retard the venous circulation. This results in effusion into the sac and into the incarcerated gut or any other organ which may be present.

This effusion increases the pressure in the sac and con-

tents, and continues until the height of the arterial pressure is reached when obviously no more fluid can be pumped into it and strangulation is complete.

Any gut present in the sac will suffer the greatest injury on account of the pathogenic germs, always present, attacking the tissues as soon as the resistance is sufficiently lowered by the poor blood supply to allow infection to take place.

In the gall-bladder it often determines the pathological condition. From this cause, in a distended gall-bladder, with an obstructed cystic duct *in the presence of germs* to produce the infection, empyema or gangrene will result. The firmness of the gall-bladder wall offers much greater protection to its circulation than does the intestine, or the appendix, nor is *complete* obstruction so common—the concretion does not commonly form in the very mouth of the duct as it does in the appendix and consequently does not make such a perfect ball valve.

In common duct obstruction infection is much less likely to take place because of the ability of the liver to take up fluids from the bile ducts and thus to keep down the pressure.

The question has often presented itself to me whether this same circulatory interference were not an important factor in gastritis and in ulcer of the stomach. It is conceivable that a heavily loaded stomach might have sufficient interference with its two exits, the œsophagus and the pylorus—to allow sufficient distention to take place to materially interfere with the circulation in the walls of the stomach, particularly the mucosa.

Minute traumatisms and ecchymotic hemorrhages which are early features of this distention should receive due consideration in this connection.

In all abscesses this effusion and pressure upon blood vessels is very marked. The location of the most vulnerable blood vessels in the abscess wall being the first to succumb, determines the direction in which the pus will burrow.

Thus is explained the greater likelihood of an abdominal abscess rupturing into the bowel than anywhere else.

If a considerable surface of gut goes to make up a part

of the wall of an abscess the blood vessels in that wall will have only the thin membrane like intestinal wall to protect them from pressure. There is no possibility of their being backed up behind by exudate as that is a mucous surface.

As the abscess wall is put upon the stretch the effect upon the intestinal blood vessels is the same that it is when the pressure is from within the gut. By stretching, all interstices in the wall are blotted out and circulation is out of the question. The effect is the same as the steady pull upon the broad ligament when operating in the pelvis. As long as it is kept taut there is no bleeding, but when this tension is relaxed the blood vessels reopen and hemorrhage appears.

The vessels in the abdominal wall, for instance, have thick cushions of tissue to resist this stretching and consequent obliteration, with many blood vessels to reinforce those in the abscess wall.

With the help of the ubiquitous omentum the peritoneal exudate which makes so large a proportion of the wall of abdominal abscesses can go on indefinitely backing up with more exudate to take the place of the gradual necrosis going on "at the front."

Many other conditions which are affected by this circulatory disturbance from distention might be discussed. This is not an attempt at making this an exhaustive catalogue. I will only suggest for consideration the following:

Intestinal distention in typhoid fever with its greater danger of perforating ulcers and hemorrhage. Its importance in all forms of ileus only casually suggested by Kocher,[1] but really one of the greatest factors in the multiform pathology of that condition. Intra-cranial pressures, so beautifully demonstrated by Cushing.[2] Overdistentions in the urinary tracts, bladder, ureters and kidneys. Effusions into joints, with or without pathogenic germs being present. Fluids in tumors. And even in excessive uterine distention in pregnancy

[1] Ueber Ileus, Mitth. aus der Grenzgebieten der Medizin und Chur., vol. iv, 1899.

[2] Am. Jour. Med. Sci., September, 1902.

this mechanical burden upon the circulation should be given due consideration.

In the past few years much work has been done upon absolute pressures in the blood vessels, but outside of these there is still a wide field for investigation. The hydraulics of the body are worthy of much greater prominence than have been given them.

I wish to express my obligations to Dr. Geo. E. Tucker of Riverside, Cal., and to Dr. Haven Emerson, of New York City, for their valuable assistance and helpful suggestions.

# ABNORMAL ILEO-APPENDICULAR FOLD AS A CAUSE OF PARTIAL OCCLUSION OF THE BOWEL.

BY C. HAMILTON WHITEFORD, M.R.C.S., L.R.C.P.,

OF PLYMOUTH, ENG.

A well-preserved, active man aged fifty-two, was sent to me by Dr. R. H. Clay. For the last twenty years he had suffered from discomfort in the abdomen. For the last four years, the discomfort had increased into intermittent colic.

When first seen in January, 1906, the colic, although of daily occurrence, was not of sufficient severity to make his life a burden. Operation was therefore not advised.

When seen again in November, 1906, the colic, although somewhat less frequent, had become much more severe. The attacks of pain, most intense in the region of the umbilicus, now lasted several hours, and were often relieved by muscular exercise or pressure on the abdomen.

In the last nine months the patient had lost in weight ten pounds. He has been living chiefly on milk. Constipation is habitual. He is never sick. Except for the colic, he is in good health. He has never had jaundice or any abdominal illness.

The abdomen was slightly distended and resonant, especially below the umbilicus. Gurgling in the right iliac fossa can always be elicited on palpation.

No peristalsis visible. No history of any abdominal tumor during the attacks of colic. Nil abnormal felt.

*Per Rectum:* Nothing abnormal to be felt.

*Urine:* Acid. Nil abnormal.

The patient feels that he cannot go on in his present condition of repeated severe pain.

*Diagnosis:* Partial obstruction of small intestine.

*Operation:* On 4th November, 1906, the abdomen was opened through the lower right rectus. The appendix was normal. The small intestine was empty (the result of purgatives and enemata) with one loop tied down to the right side of the pelvis. The bowel affected was the lower ileum, which for three

inches from the ileocæcal junction upwards was anchored to the right pelvic brim by a fold of peritoneum, which resembled a second mesentery and contained well-marked blood vessels. This fold was attached at one end to the convex surface of the ileum, *i.e.*, exactly opposite to the attachment of the mesentery proper, for three inches. The other end of the fold was attached for two inches to the pelvic brim. The width of the fold from ileum to pelvic brim was one inch. Towards the right the fold was continuous with the meso-appendix and peritoneum of the iliac fossa. Towards the left the fold ended in a free edge.

The rest of the small intestine was absolutely normal, as were the other abdominal contents. There were no adhesions. The free border (*i.e.*, the left border) of the fold was divided for one and a half inches between catgut ligatures.

*After History:* Seen on 21st February, 1907, the colic has disappeared, but, as might be expected, he is still at times troubled with "wind."

*Comments.*—The fold of peritoneum angled the ileum in such a manner that, with moderate distension of the ileum, a kink would be formed sufficient to cause partial, or even complete occlusion of the lumen of the bowel. Why the symptoms commenced in middle life is not obvious.

The fold is an exaggerated form of the normal ileo-appendicular fold described by Moynihan on p. 88 of his book on "Retro-peritoneal Hernia." The following details are extracted from Moynihan's description:

"The fold extends from the lower border of the ileum—that directly opposite the line of the mesenteric attachment to the anterior surface of the meso-appendix. It is quadrilateral in outline. The upper border is attached to the ileum for an extent which is extremely variable. An average length would be between 1½ to 2½ inches."

"Its left or inner border is concave to the left and free. This edge contains the recurrent or ileo-appendicular artery, given off almost immediately below the level of the ileum from the main appendicular artery."

"The arteries are everywhere accompanied by veins."

"Between the two layers of peritoneum in the fold are also seen some muscular fibres."

"Luschka considered that this fold acted as a regulator between the ileum and cæcum, keeping a proper and advantageous relative position

for these viscera. By means of this fold the assumption by the ileum of any extraordinary and vicious position is prevented."

The fold in the above case differed from a normal fold in (1) being attached to the pelvic brim, (2) its width, measured between its attachments to the appendix and ileum, being much less than usual.

# A NEW LIVER SUTURE.*

BY VAN BUREN KNOTT, M.D.,

OF SIOUX CITY, IA.

In this brief paper I desire to present a form of liver suture, simple, easy of application and efficient as a means of securing approximation of the tissues as well as hemostasis. As it is the intention at this time to present merely a preliminary report which I hope to supplement later by an article dealing more exhaustively with the subject of liver surgery no general discussion of the subject will be attempted.

The surgery of the liver, with the exception of the gall bladder and ducts, has not advanced during the past decade as rapidly as has abdominal surgery in general and standing prominently in the foreground as chief among the reasons preventing such advance has been the fear of hemorrhage.

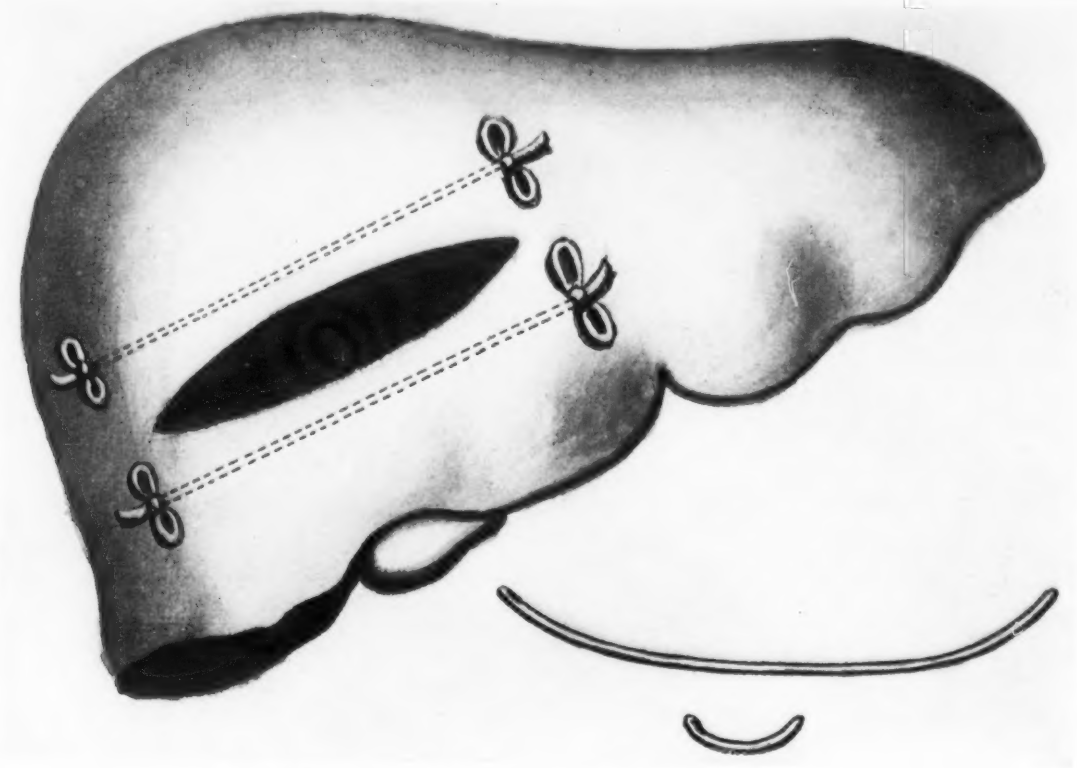
During the last few years many investigators have attempted to solve the problem and much time and ingenuity have been expended in the efforts to secure a suture which would effectually control hemorrhage and produce coaptation of the liver wound. Many of the methods reported have been most ingenious, but most of them have presented one or both of the following drawbacks. First, more or less difficulty of execution and the necessity for limiting the suture to a comparatively small area of liver tissue; second, the necessity for leaving behind in the peritoneal cavity some non-absorbable or slowly absorbable material forming part of the scheme of the suture.

Without further discussion of the methods hitherto published I shall describe a suture which experimentally has proven very satisfactory in my hands.

This suture will permit the coaptation of a wound of the liver substance at the same time controlling the hemorrhage

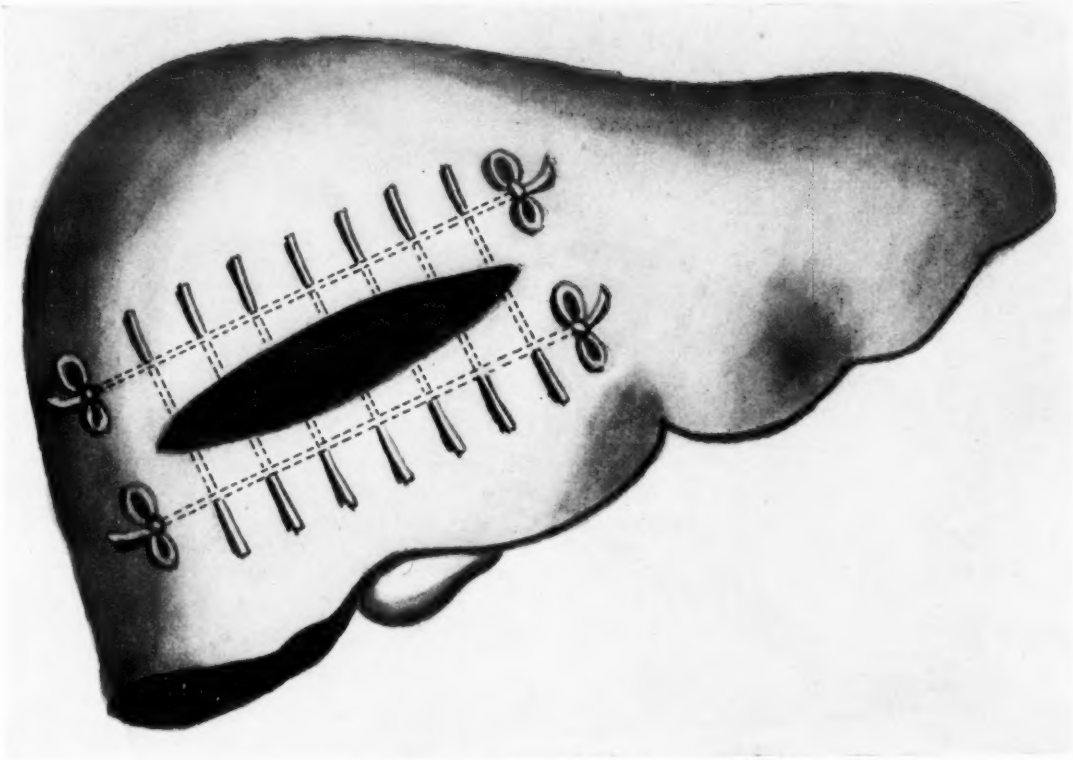
* Read before Iowa State Medical Society, May 17, 1907.

FIG. 1.



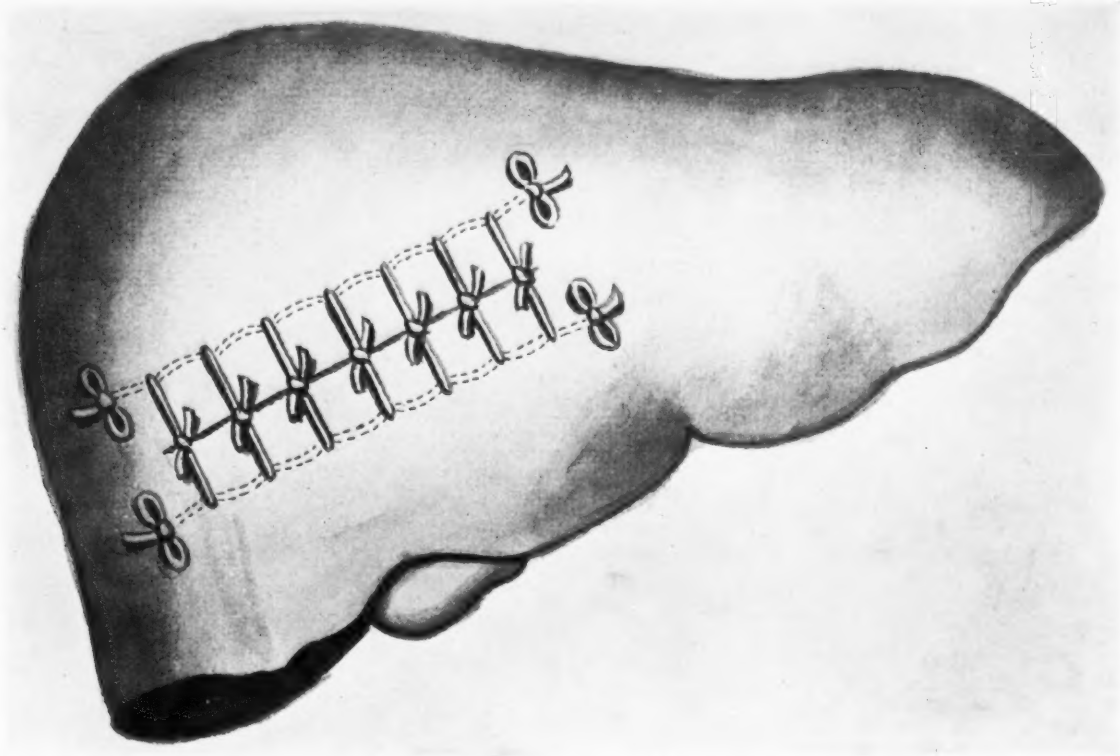
The sunken catgut strands in the tissue parallel to the wound to be sutured.

FIG. 2.



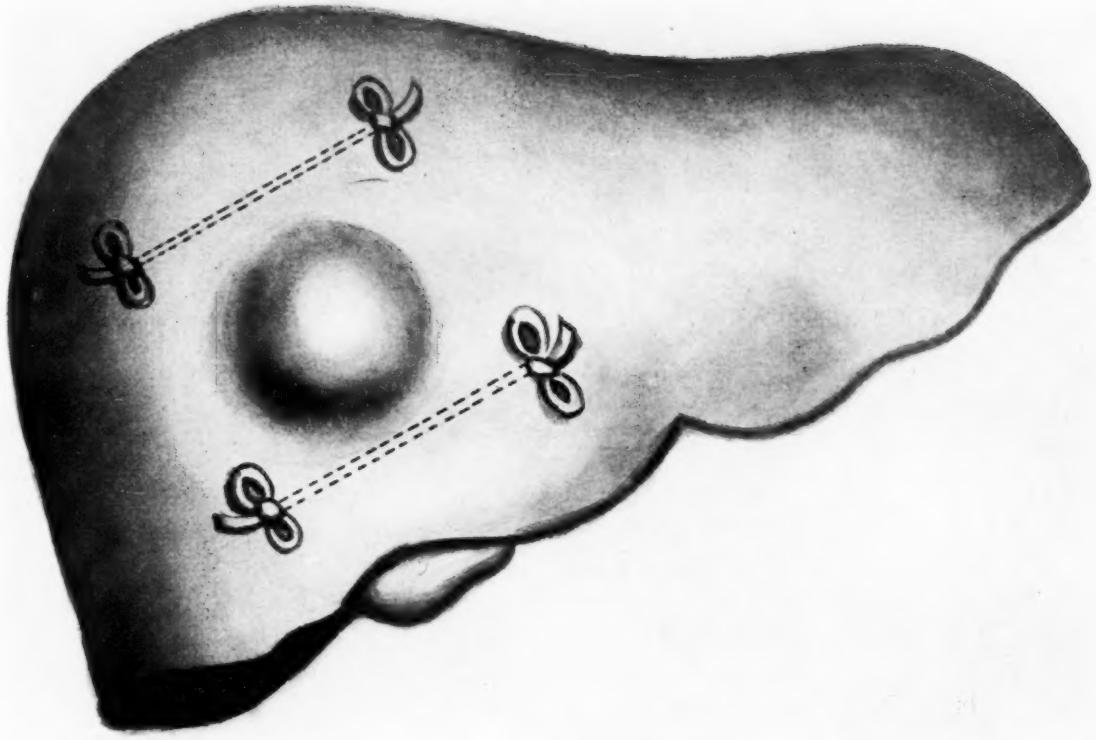
The transverse interrupted sutures introduced.

FIG. 3.



The transverse sutures tied.

FIG 4.



Long parallel sutures introduced as a preliminary to the excision of a tumor from the liver.

without the necessity for packing and will also permit the resection of large or small areas of tissue for the radical extirpation of liver tumors.

Parallel with the wound in the liver or with the area to be excised and about one half inch from its edge upon either side insert deeply through the liver substance by means of a large, round, blunt needle shown in figure 1, a strand of No. 3 catgut. These needles, as well as the small, blunt needle mentioned later, are modifications of Kousnietzoff's liver needles which have been so successfully used and have proven very satisfactory. These strands should enter the liver tissue about one inch beyond the edge of the wound, run deeply through the liver substance and emerge the same distance from the opposite end of the wound. The ends of these catgut strands are now fastened by drawing them up snugly and tying to either end of both strands a small ordinary skein of catgut, which presenting a broad surface against the liver tissue prevents the indrawing of the suture ends. Transverse interrupted sutures (Fig. 2) of No. 3 catgut are now introduced by means of a small, blunt needle, also shown in Fig. 1, in such a manner that they engage upon either side of the wound the buried long strand of catgut. These may be tied as rapidly as introduced and exerting their traction upon the buried long suture may be tied snugly (Fig. 3) ensuring hemostasis and coaptation without the danger of their cutting out.

When it is desired to remove a portion of the liver tissue carrying with it a tumor this may be done by excising between the buried long sutures (Fig. 4) a wedge-shaped ellipse of liver substance and introducing the transverse sutures as above described.

Hemorrhage during this procedure may be controlled either by manual pressure or by elastic ligature until the transverse sutures are tied when it will immediately cease.

If desired any large veins presenting along the cut surface may be tied as recommended by Keen by placing a ligature about them with a small needle carrying fine catgut which precaution in my experimental work I have found unnecessary.

I have not yet had an opportunity to employ this suture upon the human being but should not hesitate to rely upon it at the first opportunity. In many experiments upon dogs I have found that it was possible to remove various amounts of liver tissue up to one half of the organ beyond which amount I have not tried to go and also that hemorrhage from any sort of a wound large or small in the liver substance could be in this manner easily controlled.

As the material used in this suture is plain catgut which having served its purpose will be absorbed the necessity for an open wound, gauze packing, etc., may in most cases be eliminated.

I do not offer this method as one that is perfect nor do I care to make any extravagant claims for it as my experience with it is as yet too limited. I offer it with the hope that as opportunity permits you will try it and demonstrate its value or its shortcomings.

# THE OPERATIVE TREATMENT OF CALCULI IMPACTED IN THE PELVIC PORTION OF THE URETER.

BY HUGH M. RIGBY, M.S., F.R.C.S., ENG.,

OF LONDON, ENGLAND.

Assistant Surgeon to the London Hospital; Surgeon to the Poplar Institute for Accidents

THE operative treatment of stones impacted in the lower portion of the ureter has of late received a good deal of attention. During the last two years, I have operated on seven occasions at the London Hospital for the relief of this condition.

An investigation of the literature of the subject shows that the surgical treatment of impacted stone in the pelvic portion of the ureter is a comparatively recent achievement.

Fowler (in Annals of Surgery, 1904, XL. 943) gives a good account of the progress made in the operative treatment of these difficult cases. He states that Bardenheuer in 1882 was the first to remove a stone from the upper part of the ureter by the iliac extraperitoneal route. Even as late as 1898 the statement was made that stones impacted in the pelvic portion of the ureter were inaccessible to surgical treatment. Hurry Fenwick ("Obscure Diseases of Kidney," 1903, p. 151), however, removed a stone from the juxtavesical part of the right ureter by the perineal route in 1895. In 1892 Cabot (" International Journal of Medical Sciences," No. 103, p. 43) suggested that stones so placed could be removed by a modified Kraske operation, but the necessary severity of this procedure has condemned it as a routine method of treatment. Further Henry Morris (Surgical Diseases of Kidney and Ureter, 1901) showed that stones could be removed from this portion of the ureter in the female at any rate by a sacral route which did not involve any removal or division of the sacrum or coccyx.

Several recent writers have proved that stones impacted even in the portion of the ureter between the pelvic wall and the wall of the bladder can be removed by the inguinal extraperi-

toneal route. The difficulties of this operation however in a fat subject, and the fact that in the female the base of the broad ligament has to be encountered, are sufficient reasons for attempting some other means of access to this portion of the ureter. In certain cases where local removal is impracticable, stones can be displaced upwards owing to dilatation of the ureter above the site of impaction and they can then be removed by the inguinal route.

The extraction of a stone from the juxtavesical portion of the ureter has been carried out through the rectal wall on one occasion, the case was fatal and the operation is never likely to be repeated. A successful case of removal of a stone from the pelvic portion of the ureter by a transperitoneal operation is reported by Stewart,[5] but in the light of recent experience this route is no longer practised. An extraperitoneal operation is the method of election in all cases owing to the great risk of leakage and peritoneal infection by the transperitoneal route.

The writer of this article has exposed the ureter from below by a pararectal operation on four different occasions and has successfully removed stones in three of these cases. In the fourth the ureter was exposed and thoroughly explored with a bougie from the kidney to the bladder, but the stone had probably been passed.

Statistics of recorded cases show that the juxtavesical portion of the ureter or that portion between the pelvic wall and the bladder is a comparatively common site for impaction of a ureteral stone.

Henry Morris (loc. cit.) in 45 cases found: 19 within 2 inches of the bladder; 15 close to the vesical wall; 11 at the level of the brim of the true pelvis.

Schenck[6] in 1901 out of 84 cases, found that in 68 the site of impaction was stated as follows: 19 within 6 centimetres of the kidney; 8 at or near the brim of the pelvis; 41 within 2 inches of the vesical opening, *i.e.*, 50.6 per cent. of these cases were in this position.

Bovee[7] collected 64 operations in which an impacted calculus was removed by the extraperitoneal route.

In 57 of these cases: 22 were found at the upper constriction; 17 at the pelvic brim; 18 close to the bladder wall.

The operative treatment of stone impacted in the upper portions of the ureter need not be considered at length as on this point there is unanimity of opinion. The portion of the ureter extending from the pelvis of the kidney down to the point where it leaves the lateral wall of the pelvis can be exposed with comparative ease by the lumbo ilio inguinal incision. The peritoneum is raised up and the ureter which always adheres to this structure is defined. In the male subject if not too fat the portion of ureter between the pelvic wall and bladder can also be exposed. In a fat subject this may be very difficult and in the female impossible owing to the broad ligament. In all cases when possible the stone should be displaced upwards and removed high up. It is not always necessary to make the lumbar incision, an inguinal incision as for exposing the external iliac vessels need only be employed. Again there is little difference of opinion as to the methods of reaching stones impacted in the vesical orifice of the ureter or in the portion which traverses the bladder wall. The object of this communication is to especially discuss the operative treatment of stones impacted in the so-called juxtavesical portion of the ureter, that is, a portion about 3 inches in length which extends between the bladder wall and the ischium. More especially when the high route or inguinal extraperitoneal method is difficult or actually impracticable.

CASE 1, in my series, illustrates a third condition which renders an inguinal operation impossible for stones impacted in this part of the ureter. In this patient a stone had already been removed by the inguinal route and another had formed in sitû, it was therefore impossible to again strip up the adherent peritoneum from the iliac fossa and brim of the pelvis.

The juxtavesical portion of the ureter is inaccessible from above in:

(1) A male subject with a fat abdominal wall.

(2) A female subject owing to the presence of the broad ligament.

(3) Cases where a stone has recurred in sitû after the inguinal operation.

The alternative operations which have been employed for exposing this portion of the ureter are:

(1) Transperitoneal. (2) Perineal. (3) Parasacral or pararectal without removal of bone (*i. e.*, the operation performed on these four cases). (4) Parasacral or pararectal with removal of a portion of the sacrum or coccyx. (5) Vesical (with dilatation of the vesical orifice of the ureter). (6) Rectal route. (7) Vaginal route.

The criticism already applied to the transperitoneal route, namely, risk of leakage, more than ever applies to removal of stone by this method from this part of the canal.

The perineal route must be very difficult and has peculiar risks attached to it. There is real danger of wounding the rectum, hæmorrhage is usually free, the vesiculæ and vas deferens may be damaged and it is quite impossible to apply sutures to the ureteral wall and difficult to insert bougies afterwards. Notwithstanding the brilliant result in Mr. Hurry Fenwick's case already mentioned this operation will probably never become a popular one.

In the female the vaginal route is the operation for choice when a stone can be easily felt by the examining finger. The risks are small and the danger of a subsequent fistula is not great. If the ureter is not adherent it may be easily pulled down by a blunt hook and sutures applied if thought necessary. The rectal route is rightly condemned and requires no further comment.

The vesical route is very difficult and the extraction of stones by dilating the vesical orifice of the ureter hardly feasible unless they be either very close to or impacted in the bladder wall.

There remains for discussion the so-called posterior or inferior routes of access to this portion of the ureter.

The principle in these operations is to reach the ureter from below by opening up the pararectal subperitoneal tissue.

Mr. Henry Morris (loc. cit.) has shown that this is pos-

sible in the female, and this paper deals with four similar operations performed on male subjects.

The ureter was reached with ease in three out of the four cases. In the fourth much difficulty was experienced for special reasons which will be mentioned presently. It was not found necessary to remove any portion of the sacrum or coccyx. The operative procedure employed is not in the least a new one but followed the teaching of Henry Morris and other authorities supplemented by practice on the dead subject. The description of the operation employed in these four cases is as follows:

The patient is placed on the side opposite to that on which the stone is impacted. The semiprone position is employed with the knees well flexed. The pelvis is raised by a small sand bag. The edge of the coccyx on the affected side is well defined by palpation with the fingers from outside. An incision 3½ inches in length is made, extending backwards from a point 2 inches from the posterior border of the anus. This incision is half an inch from and parallel with the edge of the coccyx, it passes upwards and outwards lying obliquely to the middle line of the body. The gluteus maximus muscle is exposed and its fibres completely divided for about two inches or more.

The great sacrosciatic ligament and the posterior portion of the ischio rectal fossa are thus exposed. The small and great sacrosciatic ligaments are next divided and the spine of the ischium must be clearly defined with the fingers. This bony point is the first important landmark in the operation.

The fibres of the coccygeus muscle and usually some of the posterior fibres of the levator ani come into view. The former are scratched through with a blunt dissector. The rectal fascia is next exposed and treated in the same manner. The subperitoneal space is then revealed, but the rectal wall itself is not defined.

The ureter is next sought for in the subperitoneal tissue. This is the most difficult part of the operation as the ureter remains closely connected to the peritoneum and is somewhat firmly embedded in the subperitoneal fat. It may also be surrounded by a plexus of vessels.

The position of the spine of the ischium is again noted and the ureter sought for lying about ¾ inches above the spine in the axis of the operation wound. The best method of searching for the ureter is to use two pairs of long dissecting forceps. The peritoneum and subperitoneal tissue should be caught by the one pair and pulled up from the depths of the cavity. By fixing the peritoneum in this manner the dissection is made much easier. If this precaution is not observed the peritoneum is easily stripped off the lateral wall of the pelvis and tends to sag further and further towards the opposite side and deeper from the surface.

If difficulty is still experienced in finding the ureter and a stone cannot be palpated by a finger passed into the wound deep pressure should be made by an assistant on the abdominal wall in the pelvic region.

Further it is especially important to avoid needless stripping up of the peritoneum as this opens up a greater area of subperitoneal space which may later become septic.

If the ureter is still hidden a search forwards towards the base of the bladder will expose the apex of the vesical seminalis and having defined this the ureter will be found lying close to its inner border.

When the ureter is found and the stone located the latter is if possible displaced to another part of the canal. A longitudinal incision is then made and the stone extracted. A ureteric bougie is then passed down to the bladder and upwards to the kidney. This procedure is important as a stricture may also be present. The opening in the ureter is then closed by fine absorbent catgut sutures inserted after the Lembert principle, the mucous coat must on no account be penetrated by these sutures. A drainage tube is then passed down to the site of the incision. The sacrosciatic ligaments are then sutured with chromic catgut, then the fibres of the gluteus maximus and finally the skin wound leaving an opening at one end for the tube. The opening in the ureter need not necessarily be sutured but in my cases the sutures were inserted without any difficulty.

THE AFTER EFFECTS OF THE OPERATION.

In each of these four cases some leakage of urine took place from the wound for a few days. With one exception the wounds healed rapidly and the tube sinus quickly closed.

In Case 4 some fresh leakage occurred later and the sinus reopened and discharged pus, but the dependent position of the track allowed natural drainage and checked any tendency to extension of suppuration.

The result of division of this small portion of the gluteus maximus was insignificant, some wasting of the posterior part of the muscle could be seen but in two of the patients, observed 12 months after the operation, no appreciable loss of muscular power was experienced.

The advantages of this operation:

(a) The abdominal wall is not incised and therefore the risk of a ventral hernia is absent.

(b) The ureter is directly approached from below and the great disadvantage of stripping up the peritoneum and opening up the retroperitoneal space is avoided.

(c) The hæmorrhage in this operation should be trifling as no vessels of any size are encountered.

(d) There is no risk of damage to the iliac vessels either by carelessly stripping up the peritoneum or later by the presence of the drainage tube.

(e) The position of the wound ensures perfect drainage in the recumbent position.

(f) In the inguinal operations this portion of the ureter lies at a greater depth from the skin surface especially in a fat subject. The actual depth from the surface at which the ureter lay in one of my patients was by measurement 3½ inches.

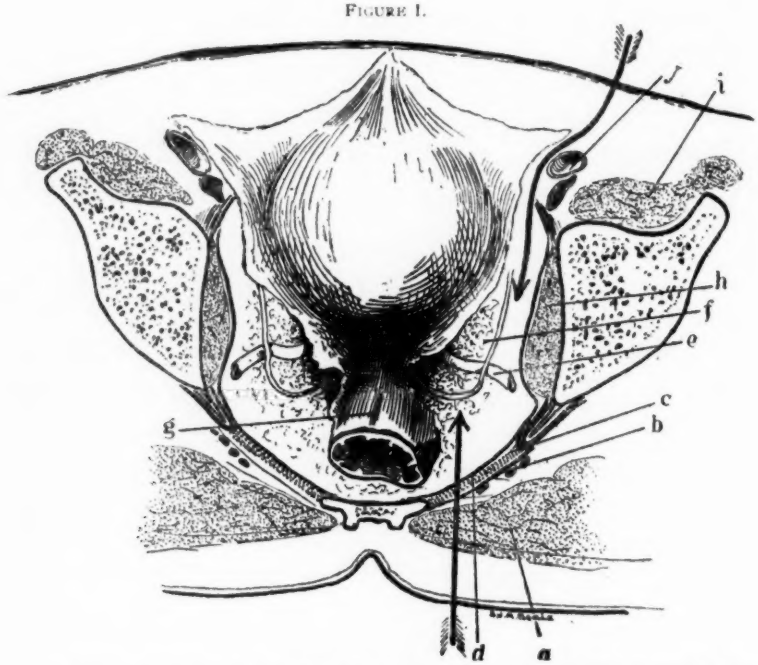
(g) The ureter can be pulled up within easy reach so that sutures can be introduced accurately without any difficulty.

If the stone cannot be felt there may be great difficulty in defining the ureter. In Case No. 3 where a small stone was fixed in the paraischial portion the ureter could not be defined until a transperitoneal exploration was also made. In Case

No. 4 on the other hand the ureter was easily found, although no stone was present. In Cases 1 and 2 no difficulty was experienced.

Figure 1 is a section made from a frozen pelvis. The section was made through the lower portion of the coccyx posteriorly and just above the pubes anteriorly.

FIGURE 1.




*a*, Gluteus maximus; *b*, sacrosciatic ligaments; *c*, coccygeus muscle; *d*, rectal fascia; *e*, ureter; *f*, vas deferens; *g*, rectum; *h*, obturator externus; *i*, iliacus; *j*, ext. iliac vessels.

This section includes the tissues involved in both the inguinal and pararectal operations. The arrows show the paths taken in exposing the ureter by these two routes.

Figure 2.—This is a drawing made from a longitudinal section of the female pelvis by Mr. Arthur Keith. The specimen is in the Museum at the London Hospital Medical College.

The cervix uteri has been removed so as to expose the path of the ureter beneath the broad ligament.

The following is an abstract of the Cases on which this communication is based:

Case I.—E.B., aged 21 was admitted into the London Hospital on January 6th, 1905. He gave a history extending over a period of two years of recurring attacks of right renal colic. He had never noticed any alteration in the urine.

A radiograph was taken and showed a distinct shadow in the right kidney just below the last rib.

On January 13th, 1905, a stone composed of uric acid and phosphates was removed from the cortex of the right kidney. A bougie was passed down the ureter into the bladder without encountering any obstacle. The wound was partially closed and an uneventful recovery followed. He left the Hospital on February 9th, 1905.

On August 21st, 1905, he was re-admitted with the following symptoms. Pain in the glans penis during the act of micturition. This commenced about 3 months after leaving the Hospital, and has continued on and off up to the present time. When the pain is severe he has increased frequency of micturition both during the night and day. He has never noticed any hæmaturia. In addition to the penile pain he has had aching in the right loin in the site of the scar.

On admission. The scar looked quite healthy. The right kidney could not be felt and was not tender even on deep palpation. There was no tenderness along the course of the ureter. A rectal examination revealed a tender point at the base of the bladder on the right side but a calculus could not be felt. A radiograph was taken and a distinct shadow could be seen in the right ureter apparently just above the right ischial spine. The urine was acid contained pus corpuscles, a small trace of albumen, no blood, no casts. The amount of urine passed per diem was 18 to 22 ounces.

On August 26th, 1905. An incision was made above and parallel with Poupart's ligament on the right side. The muscles of the abdominal wall were divided and the peritoneum stripped up from the right iliac fossa. The ureter was exposed and followed down as far as possible but the stone could not be felt. A small opening was made in the ureter and a probe was passed down. This was stopped apparently just outside the bladder wall.

A finger was then inserted into the rectum and the base of the bladder and lower end of the ureter pushed upwards. A small stone could then be easily felt. The ureter was traced further downwards after some difficulty and an attempt was made to displace the stone upwards but without success. An incision was then made over the impacted stone and it was extracted. The two openings made in the ureter were closed by fine silk sutures including the serous muscular coats only. The lower opening was closed after very great difficulty. A drainage tube was left in sitû and the wound partially closed. A discharge of urine took place from the tube for a week. The tube was removed on September 4th and the patient left the Hospital well on September 23rd, 1905.

On February 23rd, 1906, the patient was re-admitted into the Hospital with recurrence of similar symptoms, namely, severe penile pain during micturition, slight increased frequency but no bleeding. The urine was found to contain albumen and pus in small quantities. A radiograph again showed a calculus in the right ureter apparently in the same position as the previous one.

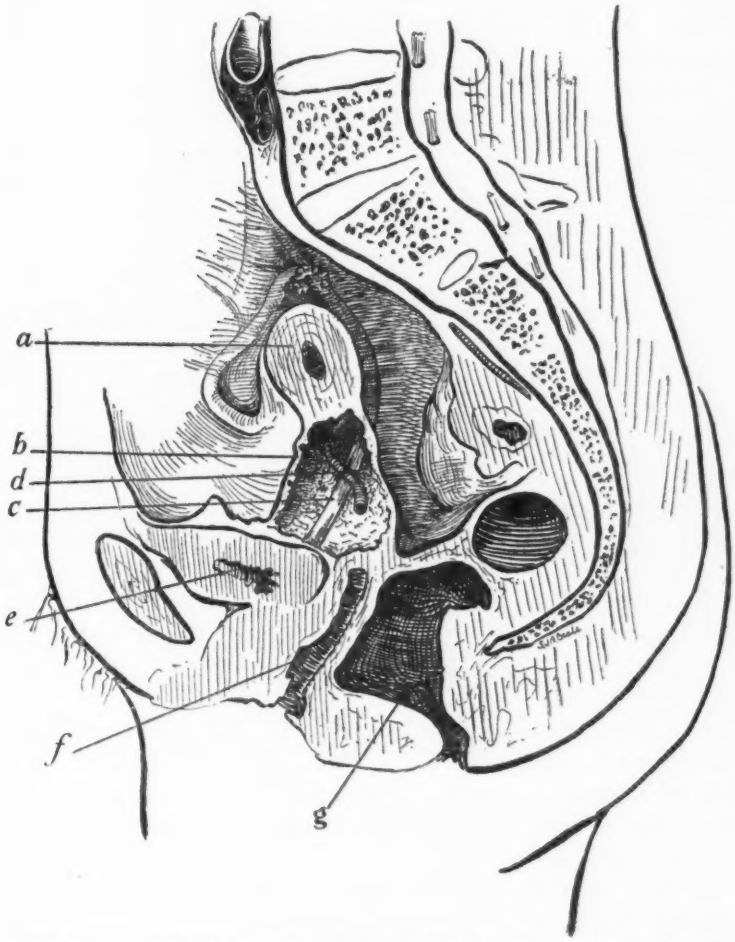
On March 9th, 1906, a transperitoneal operation was made to try and shift the stone upwards from the pelvis to the upper part of the ureter. The patient was placed in the high Trendelenberg position and the attempt was made through an incision in the right semilunar line. The stone, however, was firmly fixed and could not be shifted at all. An endeavor to restrip the peritoneum from the right iliac fossa proved futile as it was firmly bound down by adhesions from the previous operation. The abdominal wound was therefore closed and the patient sent back to bed.

On March 16th, 1906, the patient was again anæsthetized and the stone was removed by a pararectal operation as described above. There was little difficulty in the operation, the stone was found and the ureteral incision sutured with fine catgut sutures. The depth of the ureter from the surface in this case was measured and found to be 3½ inches. A drainage tube was left in and the wound and muscles partially closed by sutures.

There was leakage of urine for 48 hours from the wound but never in any large amount. The wound healed well and the patient left the Hospital on April 13th. The calculus which was removed was composed of phosphates and in its centre was found a small silk suture evidently one of those introduced at the last

operation. Since this date the patient has passed two small phosphatic stones via the urethra after more or less severe attacks of colic. Each of these stones contained small silk sutures. The last of these was passed on February 5th, 1907.

FIGURE II.




*a*, body of uterus; *b*, broad ligament; *c*, ureter; *d*, uterine artery; *e*, bladder; *f*, vagina *g*, rectum.

CASE II.—F.P., aged 10, was admitted into the Poplar Hospital on May 15th, 1906. For three months he had complained of recurring attacks of pain in the right loin and right side of

the abdomen. The attacks were severe and accompanied by hæmaturia. There was no pain in the penis but the pain during the height of the attacks radiated to the bladder, right groin and testicle.

A radiograph showed a well marked shadow in the region of the right kidney and another close to the bladder in the right ureter. The bladder had been sounded with a negative result. A stone could not be felt on rectal examination.

On May 26th, 1906, a stone was removed from the right ureter by a pararectal operation. The ureter was easily found as the stone could be felt in the bottom of the wound. The stone was extracted and the urethral opening sutured with fine catgut.

An incision was next made in the right lumbar region and a stone removed from the pelvis of the right kidney. The two operations took 45 minutes. There was a little leakage as usual from the pararectal incision for about five days. The two wounds healed well and the patient left the Hospital on June 24th.

Fig. 3 is a photograph taken three months after the operation. (Fig. 3.)

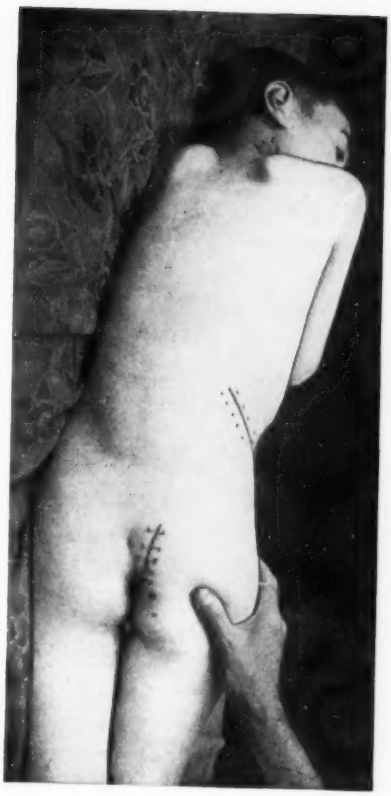
Case III.—F.J., aged 35, was admitted into the London Hospital on January 16th, 1907. He complained of recurring attacks of severe colic on the right side. The first attack was in August, 1906. The attacks lasted from 3 to 5 days. He was quite free from pain in the intervals. On one occasion the pain radiated to the right testicle. He never had pain in the glans penis. Blood was never noticed in the urine and there was no frequency of micturition.

On October 10th an examination of the abdomen and by the rectum revealed nothing abnormal. The urine was normal. A radiograph was taken and a distinct shadow could be seen just below the pelvic brim on the right side. He was recommended to take large quantities of fluid in the hope that the stone would pass into the bladder.

On November 10th a second radiograph was taken. During this interval he had one further attack of severe colic. This radiograph appeared to show that the stone had become displaced downwards and was now lying just above the ischial spine.

He persevered with the palliative treatment and between this date and January 4th, 1907, he had four further attacks of colic. He had no increased frequency, hæmaturian or penile pain.

FIG. 3.



CASE II.—Photograph of scar left after the pararectal operation.

A third radiograph taken January 10th showed that the stone was in the same position. Operation was advised and performed on January 19th, 1907. The pararectal route was adopted as the stone was thought to be lodged in the juxta vesical part of the ureter. The pararectal space was opened up but the ureter could not be defined and no stone was felt. After a prolonged search a small incision was made in the right semilunar line and two fingers were inserted into the peritoneal cavity. The ureter was then palpated with two fingers in the pelvic cavity and one in the pararectal space. The ureter could thus be easily defined although no stone was felt, on tracing the ureter upwards a very small stone could be felt lying against the lateral wall of the pelvis above the ischial spine. The ureter was next defined from the pararectal wound assisted by the fingers in the abdominal cavity. A small incision was made in its wall and a probe passed upwards for 1½ inch struck against the stone. A pair of urethral forceps were next inserted and pushed up the ureter and after several attempts a small rough oxalate stone was grasped and easily extracted.

The incision in the ureter was closed as before with fine catgut. The small incision in the right semilunar line was next closed and the parasacral incision partially closed. The after progress of this case was prolonged owing to late thrombosis occurring in the left femoral vein. The wound by the coccyx leaked urine for four days, then healed up slowly.

On February 10th signs of thrombosis developed in the left femoral vein and on February 27th patient suddenly developed symptoms of pulmonary embolism. This he recovered from but the thrombosis of the leg persisted.

On March 4th a fresh collection of pus developed in the track of the drainage tube in the parasacral wound. This was evacuated and after a few days the wound again closed. Further progress was uneventful.

The difficulties experienced in this case were entirely due to a wrong appreciation of the position of the calculus. It would certainly have been wiser to have approached the ureter in this case by the inguinal route. The patient was a stout muscular man and this added considerably to the depth of the ureter from the surface.

Case IV.—W.M., aged 54, was admitted into the London

Hospital on August 4th, 1906. She complained of being ill for 5 or 6 years but much worse for the last 6 months. The chief symptoms are pain in the left loin radiating down to the hypogastrium and scalding pain in the urethra during micturition. There is much increase in frequency and blood was noticed in the urine on one occasion. An abdominal examination was negative. On vaginal examination a hard substance could be easily felt in the left fornix apparently close to the cervix uteri.

A radiograph showed two definite shadows in the region of the left kidney and a rather large elongated shadow in the pelvis apparently in the lower portion of the left ureter.

On August 13th, 1906, an anæsthetic was given and vaginal examination again revealed the presence of a stone in the lateral fornix. The bladder was cystoscoped. The left urethral orifice appeared to be somewhat dilated.

An incision was then made to the left of the cervix uteri through the vaginal wall. A stone was reached easily; it was firmly impacted in the ureter and during extraction was broken up into 3 pieces. A vaginal douche was given and dressings applied. A small gauze drain was inserted down to the ureteral incision. The patient was then turned on her right side and the left kidney exposed by the usual lumbar incision. The kidney was found considerably atrophied. At the lower part in the cortex were found two white cheesy masses embedded in smooth walled cavities, these were evacuated. Below these and deeper in the kidney substance was found a very friable calculus about the size of a small marble. This was removed. The cavities in the kidney were drained with gauze and a drainage tube passed down to the cortex. The lumbar wound was then partially closed.

After progress. The wound in the vagina apparently healed quickly as no urine escaped at all. The lumbar wound healed rapidly and no urine escaped. All the symptoms were relieved by this operation. The patient left the Hospital on September 4th, 1906.

Second operation. This patient was again admitted into the Hospital on April 2nd, 1907. Two months after leaving the Hospital the old pains returned again. She had severe burning pains like needle pricks on micturition. The pain was chiefly in the meatus and urethra. She also complained of pain in both loins

and in the hypogastrium. She had frequency every half hour night and day. No blood was noticed.

A vaginal examination revealed the presence of another stone in the same position as before and a radiograph corroborated this, two well marked elongated shadows could be seen. The kidney region showed nothing abnormal. Abdominal examination was negative.

On April 5th, 1907, the patient was operated upon a second time as follows: An incision was made in the left lumbar region along the side of the old scar. The kidney was exposed. It was adherent but was freed and removed without difficulty. The organ was very small and the vessels atrophied. No calculus was found.

The patient was next placed in the lithotomy position. An opening was made in the vaginal wall as before and two phosphatic stones removed from the left ureter. A probe was passed up the ureter. A vaginal douche was given and perineal dressings applied. No drain was used.

The after progress of this case was uneventful and the symptoms were again entirely relieved by the operation.

In this case it would probably have been better to have removed the kidney at the first operation and so avoided the fresh formation of stones.

Case V.—S.L., aged 22, admitted into the London Hospital on February 14th, 1907.

History.—In July 1906 a stone was removed from the upper part of the left ureter at University College Hospital. In November 9th, 1906, he was admitted into the London Hospital and a stone was removed from the paraischial portion of the right ureter by the inguinal route. The wound drained insufficiently and leakage of urine was followed by spreading suppuration in the subperitoneal tissue. On December 17th, 1906, an abscess was opened in the right flank which had tracked up along the abdominal wall.

The patient left the Hospital soon after with wounds healed. The present symptoms commenced in January, 1907, in the left lumbar region aching in character sometimes radiating down along the course of the left ureter and involving the left testicle. The pain was always present but sharp exacerbations occurred two or three times a week. There was also pain in the glans penis

after micturition. There was no hæmaturia. The urine contained a trace of albumen and some pus.

A radiograph showed an indistinct shadow apparently due to a stone in the juxavesical portion of the left ureter.

On February 22nd, 1907, the pelvic portion of the left ureter was explored by the pararectal route. The ureter was found easily. It did not appear to be abnormal. A small longitudinal incision was made in its wall and a ureteric bougie passed down to the bladder and up to the pelvis of the left kidney. A stone could not be felt.

The ureter was then hooked up and two catgut sutures were inserted to close the wound. A small tube was left in sitû and the muscles and skin united. Slight leakage of urine was noticed for two days. The tube was removed altogether on March 1st, that is 7 days after the operation and the wound healed rapidly. The patient left Hospital with complete relief of his symptoms.

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